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# **INTERNATIONAL JOURNAL OF COMPARATIVE PSYCHOLOGY**

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## PREFACE

Ethel Tobach, Editor  
*American Museum of Natural History*

When Siegfried Jaeger published "Intelligenzprüfungen am Orang" in *Passauer Schriften zur Psychologiegeschichte* (1988, No. 9, Passau: Passavia Universitätsverlag und -Druck GmbH) I saw the report by Koehler as an important part of the history of the comparative study of apes, as Jaeger points out in his introduction to this issue. We are grateful to him for his historical research that made it possible for us to read the report. Above all, I thank him for his patience and help in reworking our translation, as well as for his comments. We are also most appreciative of the time taken by Parker, Rogers and Kaplan to contribute the insightful and interesting contemporary views of this interesting, and endangered, species.

As those of you who are familiar with the German version will note, I had to make decisions about editing this rather long and sometimes repetitive account, as well as to omit the notes that Jaeger published, which are important and informative. I also was constrained in republishing the photographs and sketches which are charming, but would have added considerably to the cost of the issue, and not necessarily helped in understanding the text. I bring to your attention also that I omitted portions of the text by Koehler in which he referred to differences in human populations that were based on the views of the time in which he wrote. I found that tangential to the main value of his report, which I believe to be first, the insight into the ways in which this creative scientist thought about behavior, and second, the comments he made that suggest further types of studies to be done in the comparative study of the higher apes (see particularly the comments by Parker and by Rogers and Kaplan).

Once again, I wish to thank Ruth N. Newman for her significant contribution to this issue, and to thank Muriel Williams and Pat Brunauer who produced the hard copy of the translation.

## INTRODUCTION

Siegfried Jaeger  
*Free University of Berlin*

By the end of the last century expeditions to all regions of the earth had filled the biological, anthropological and archeological collections of museums and scientific institutes with the remains of extant organisms. Then, with the growing interest in comparative studies in connection with Darwin's theory of evolution, biological research stations were founded as near to the living research subjects as possible. The establishment of anthropoid stations at the beginning of this century is part of these more general efforts to create better conditions for the study of living beings in their natural environment and made possible a qualitative improvement of biological, psychological and medical research. New areas of research, especially dynamic processes, were made accessible. The shortcomings of unsystematic observations in the colonies, the problems of animal keeping in the northern countries and the inadequacy of observations of single animals with unknown case histories, held in zoos or circuses under conditions not appropriate to their species, could be overcome. Apart from a more general interest in the endangered species of the closest relatives to humans, proposals for the establishment of anthropoid stations were rooted in a variety of scientific interests, which even included questions about the natural foundations of ethics, morals and social order. While in the United States questions of comparative psychology were of dominating interest, neurophysiological problems were at the forefront in Germany, and in France and the Soviet Union syphilis research and the breeding of animals for medical use were the main fields of interest. The creation of research stations of an international interdisciplinary character planned in Germany to correspond to the Marine Zoological Station in Naples founded in 1910, was prevented by World War I.

Most important in choosing the location of a station was its accessibility, good working conditions and, especially, convenient climatic conditions suitable for the researcher and for the different species of an-

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thropoids. In those days before the first World War this could only be achieved through compromises with regard to the natural environment and the free movement of the animals. Therefore, proposals to carry out observations in preserves located in the animals' habitats were set aside. Instead of preserves such installations were set up as the Anthropoid Station of the Prussian Academy of Sciences, on Teneriffe in the Canary Islands, in 1912; G. V. Hamilton's Animal Laboratory in Montecito, California, in 1910, which in 1915 acquired its first anthropoid ape, an orang on which Yerkes published a report in 1916; the Pasteur Institute's Station, Kindia, in French Guinea in 1923; the Yale Primate Laboratory of the Institute of Psychology of Yale University in 1925, which was completed by the Southern Division of the Yale Laboratories of Primate Biology at Orange Park, Florida, in 1930; and the Ape-Breeding Station of the Academy of Science of Georgia in Suchumi, Soviet Union, in 1927. Besides, there were also a few private collections of primates, like that of Mrs. Rosalie Abreu near Havana, Cuba, where occasional research was done. Seen from our present time, in which we have easier access to the natural habitats of the animals and can maintain them in locations of our choice, the stations appear to have been only a transitional step toward wild life observation and now have no purpose apart from breeding animals for essential medical experiments.

The psychological publications which originated in the research done in the anthropoid stations, like those of Robert Mearns Yerkes and Wolfgang Koehler, have essentially corrected and altered our view of the primates. In part, they even have had a formative effect on psychology and other disciplines, and they have made the authors prominent beyond scientific circles. However, the paper I am going to discuss here was not published during the lifetime of the author, when his influence was at its peak.

The manuscript of *The Mentality of Orangs*, which is now published in English, belongs to the literary estate of Wolfgang Koehler. Up to its publication not even persons closely connected with him knew that he had also done research on orangs when he worked at the Anthropoid Station of the Prussian Academy of Science, 1914–1920. This raises the questions: Why did he not finish the revised and almost completed manuscript? And why did he not publish it as planned, in continuation of his *Intelligenzprüfungen an Anthropoiden, I*, of 1917 (the English translation of which has the title *The Mentality of Apes*, 1925), in which he presented his famous observations and experiments with chimpanzees? This would have been well in accord with the concept of the station, which from its beginnings included comparative psychological and neurological research on chimpanzees, orangutans, gorillas, and gibbons in its program. Later, through contacts with Henry Fairfield Osborn, director of the American Museum of Natural History, attempts were made to keep even New World apes there.

Rare hints make clear that Koehler still planned to publish the manuscript many years after the station was closed in 1920 because of financial troubles. In July 1919, he reports to the secretary of the Akademie der Wissenschaften Berlin-Brandenburg, that "after the orang had finished an experimental series, the *Intelligenzprüfungen, II*, can be regarded as basically completed." The report is now in the Academy's archives. First and second drafts of the manuscript were completed the same year and further revisions followed in 1921/22; they may be seen in the library of the American Philosophical Society, in Philadelphia. The last hint known to me can be found in a 1928 letter of Koehler's to his American colleague and predecessor in scientific orang research, Robert M. Yerkes, with whom he had had contacts with only a few breaks since 1914, when Yerkes had planned to do research for a year at the Teneriffe Station.

My last paper on anthropoids, of which the greatest part is already written, is also not published. Each time I was prevented by more urgent work; and because the situation now is the same, I hardly believe I can finish it before the beginning of 1929.

The letter is now in the Yerkes papers in the manuscripts and archives division of the Yale University Library.

Aside from his time consuming work as director of the Psychological Institute at the University of Berlin and his reorientation to specific research problems in human psychology (his last paper from the Anthropoid Station, "On the Psychology of Chimpanzees," was published in 1921) there are several problematic points in the manuscript which could have prevented publication, but none is sufficient by itself. The most important fault of the orang manuscript—which Koehler himself notes—can be seen in the fact that only two of seven young orangs destined for the Station arrived at Teneriffe in June 1916, and because one died after the first observations, the experiments were restricted to only one animal. But a sole anthropoid, says Koehler, in his awareness of the methodological consequences, is totally different from the very same animal in a group of the same species. One cannot understand its behavior patterns completely, because there are no other animals to react to it, and a human is only a meager substitute. Furthermore, it is impossible to distinguish between individual psychic characteristics and achievements and those common to the species. Secondly, Koehler had planned to end the *Mentality of Apes II* with a more general theoretical discussion in answer to earlier critics of his work and as clarification of his position opposing other theoretical approaches to animal psychology of the time. This theoretical part remained fragmentary, and is therefore omitted in the translation. Also omitted are his often incomplete footnotes.

What is left is a phenomenological description of the young orangs

which display to Koehler, who had never seen orangs before, astonishing differences from chimpanzees in their anatomy, behavior, temperament, and so forth; and a research report from the year 1916 to 1919 of a female orang named Catalina. The latter is still worth reading, and not only from the perspective of a historian of science. The methods described in the report, which, as far as the specific anatomy of the orang made it possible, run parallel to the methods used in his well-known studies of chimpanzees. Koehler carefully describes how Catalina learned to use the stick, and engaged in problem solving experiments with a rope, a detour box and other tools. A section in which Koehler planned to show how she learned the double stick method is, unfortunately, missing. (See p. 75, Koehler.) At the same time he names the differences and common features of both species of anthropoids. In some examples he also makes comparisons with human beings. This is not astonishing, because all his observations and experiments aim for a better understanding of the structure of the human psyche, with respect to the laws of human psychology. According to Koehler, methodologically, the anthropoids have the advantage of being close enough to humans, albeit of lesser complexity, and are enough unlike them to allow a more objective judgment.

A strong point of Koehler's paper lies in his observation and interpretation of very basic mechanisms of behavior in situations of emotional stress. Catalina presented many occasions for such observations, for example, stick biting after unsuccessful trials, a behavior which in Koehler's opinion is widely neglected in human psychology. As he sees it, these mechanisms are not only primitive regression phenomena, but also, potentially, beginnings of tool making under the emotional pressure of a specific problem situation.

His report shows that he rejected psychological explanations that too quickly argue that associations are drawn from cumulative experience. From his standpoint of gestalt theory his interpretation is that the dynamic forces of the perceptual situation or the psychological field determine the behavior through neuronal correlates, which in extreme cases can involve the total organism by neural stimulation. Under the directive pressure of the situation such behavior can appear "meaningful" or "goal directed" without prior experience.

The results of his orang research, which are verified by recent orang studies using Koehler's methods, indicate that orangs are not inferior to chimpanzees in perception and spontaneous intelligence. Although there are immense differences in temperament, and though learning processes seem to be much slower in orangs—it remained unclear to Koehler, if this was due to Catalina's individual characteristics—the orang attains achievements which are similar to or even better than those of the most advanced chimpanzees.

The translation of the manuscript was a difficult and laborious task, for which I want to express my sincere thanks to Ruth M. Newman. The original German manuscript is in some parts very hard to follow because of detailed descriptions of research conditions; in other parts it contains brilliant formulations, whose play upon words is hardly translatable. I also want to express my thanks to the editor of this Journal, Ethel Tobach. It was her initiative that made a piece of the history of comparative psychology available to a broad international readership.

## THE MENTALITY OF ORANGS

Wolfgang Koehler

The anthropoid research station established in 1913 by Mr. E. Teuber, described briefly in an earlier publication, had to be given up in the Fall of 1918, after the property involved changed hands and was no longer suitable for use as a laboratory. Until then, the new station (El Cipres, Orotava) could not be constructed precisely enough for maintenance of the animals and for many of the observations and experiments, because only a portion of the original building material remained usable after the demolition of the earlier installation, and new material was not obtainable.

### OBSERVATIONS ON THE ORANG

In the year 1915 the Royal Dutch government permitted a number of orangs in its Asian colony to be captured for the anthropoid ape station on Teneriffe. On behalf of the Prussian Academy of Sciences I wish to express heartfelt gratitude for this invaluable support of scientific research.

Two of the animals, a male and a female, survived and were transported to Teneriffe, where they arrived in June of 1916, after a very long sea voyage. At that time I was very familiar with chimpanzees, but I had never seen orangs and could not get a precise conception of their nature from illustrations or descriptions. The expectation that I would find a variant of the chimpanzees proved to be totally false, for the first impression made by the animals was above all that of a striking difference between the new anthropoids and the chimpanzees.

The chimpanzee, with its smooth black pelt covering its sturdy frame, always gives the impression of a clearly contoured, robust body. It stands firmly on its horny soles, and the hands on which it supports itself are heavy and massive. It breaks quickly into violent motion, for power is its main characteristic. The two young orangs, on the other hand, sat in their cages like two soft, vaguely defined, pale flecks of color. Their long, fine hair fluttered in the wind with long, yellowish streamers shining iridescent in the light, so that it was barely possible to perceive them as distinct shapes, and where the skin was visible, its colors displayed tones of blue and dull yellow shading to olive green and bluish tints in the

same vague and delicate range. As always, one type cannot be contrasted with the other as graphically by listing their single characteristics as by beholding the living being, when they can be immediately and strongly differentiated. At a later age the female animal, which I observed for some time, became a little more substantial because the hair formed coarser strands, and the coloration darkened to brown; but I never saw the animal as having a truly compact body structure. When it attained full growth as a result of being well-nourished, its curious orang's fold hung horizontally below the neck; the arms and legs were attached, like slender rods, directly to the plump trunk. No orang stands firmly on the ground because its narrow, fantastically long feet, designed entirely for grasping and climbing, never touch the earth with the whole sole, which is turned inward on its side, but only with the outer edge of the foot, with the finger-like toes bent into a ring. Thus, the animal has an odd and extremely clumsy appearance on bare, solid earth. It is capable of rapid movement only among the branches. The orang seldom uses great force, but always, instead, displays a slow, tenacious strength in its extraordinarily slender limbs. An orang that has wrapped its lean, sinewy fingers or toes around some firm support cannot be torn loose from it by even a powerful man. All this became clear very gradually. On their arrival, the first impression before the particular characteristics of the two animals made them stand out as individuals, was that of a common trait that was immediately evident: How Asian they look!

At this time it is not the accepted custom in scientific thinking (research) to put much stock in the phenomenology of types or to draw conclusions from it concerning the objective characteristics and interrelationships of types. In general, it is not appropriate to do so until we know something more about the relationship between such phenomenological general impressions and the more directly determinable objective characteristics of the types. At the same time, however, one cannot deny first, as in the case at hand here, the exceptionally impressive actuality of the phenomenological type itself. One learns much more and much more vividly from this impression than from the degree of prognathism, arm length, eye placement, and so forth. Second, one cannot deny that it would occur to nobody that both organizational forms could be closely related genetically, solely on the basis of the phenomenological type impression of the orang and of the chimpanzee. On the other hand, after many years of familiarity with chimpanzees, the first baboon that I observed appeared from its body structure and its behavior (vocalization), in short, from its phenomenological type impression, to be at once the direct precursor and a near relation of the chimpanzee.

Just as chimpanzees represent a single type, distinct from orangs and also display great individual differences within their group, so the two Asian animals, although of the same general type, were likewise quite different from each other. From a purely external viewpoint it was noted

at once that the female, despite certainly being older, had a much smaller head than the male, which carried a massive head on a meager body. While the color of the latter's face shaded from very dark to black, the color of the female's was almost the same yellow tone as the upper torso. Much more striking, however, was the complete dissimilarity in the behavior of the two animals. The excitement of arriving and being transported to the station seemed hardly to abash the female; she gazed with great curiosity at everything that happened near or within her traveling cage, while the male crept into a corner, overcome with anxiety, and quickly pulled his blanket over his head as soon as anyone looked at him. His face always wore a bewildered, shy, and obedient expression. She looked about most impudently and curiously.

During the next few weeks, after the immediate aftereffects of the strains of the journey had worn off, the animals did in fact develop along the expected lines. We soon had higher expectations for the male than for the female; he looked about in such an earnestly friendly, cautious, and perhaps somewhat mournful way, while her deportment was, in general, frivolous and unconcerned. At first, they could have been taken for very quiet creatures, in comparison with chimpanzees; but only the male retained his obedient, quiet demeanor. After four days, the female had become bold, not exactly cheerful, almost carefree. When the peasants sought a suitable name for her, Catalina (Catherine) won general approval.

One of the first observations of great interest was that the female appeared above all to be good-natured. The animals had been transported overseas in separate cages, and consequently had been separated for a number of weeks. When the two containers were placed next to each other with the doors open, Catalina immediately climbed over to the male and displayed the greatest tenderness; for a long time she sat with one arm laid close around his shoulder, the other hand in his, and was visibly happy to be together with him. When an orange was offered to them, she treated it as common property. She had hardly taken a bite before she offered him the fruit and pressed it to his mouth again and again; when she wished to eat she quietly took back the fruit but returned it at once. During this, the male grew even more quiescent, retiring into himself. Such scenes were to be seen for three days, but when Catalina had become accustomed to his proximity and had recovered from the aftereffects of the voyage and became livelier, the picture changed completely. Instead of offering him her food, she began regularly to take away his, as well as whatever plaything he had in his hand. Indeed, she insisted on possessing things as soon as the male showed any interest in them—things which she had totally ignored when she was alone, things which she also scarcely noticed later, and, furthermore, things which were available in large quantities in the environment.

When the animals were first released from their cages, they staggered

painfully on their weakened, stiffened limbs to the shade of some castor bushes and sat there motionless. The large green leaves seemed to appeal to them, so they plucked them and placed them singly or several together on their heads like hats—which looked uncommonly droll—or they laid them next to or over each other on the ground before them, like a carpet, in order to then press and smooth them down with the backs of their hands, with great care and delight, and finally to seat themselves cozily upon them. But the small, feeble male could not manage by himself, for when he had broken off a few leaves, Catalina, who was squatting next to him, snatched them from his head or from the ground in front of him, although she was already well supplied, all about, within arm's reach, with leaf upon leaf on the branches.

As time went on and their growing strength urged them on to more playful activity, she tormented the male more severely. When she was not eating or sleeping, her natural pastime was rough horseplay, and her sedentary companion, who displayed the greatest aversion to that sort of play, was her unhappy victim. When he was buffeted about and nipped by her teeth he could only squeak plaintively; he could not flee speedily enough and was hardly able to defend himself with feeble snapping. When he climbed a few meters high up a tree for the first time, she threw him to the ground head over heels in her thoughtless play, so that he lay unconscious for a time, but fortunately unhurt. This appeared to disturb her, for she came down, felt him, and put her fingers in his mouth. However, when I punished her she became very ill-tempered toward me, and some days later, in my absence, during her play she threw him from high up to the ground, where for a moment he lay unconscious. As I approached, the little one was still lying motionless, and she tried anxiously to be of assistance, but broke off those efforts as soon as she caught sight of me. She hastened toward me, whimpering, and brought me agitatedly back to the male, who in fact was unhurt this time also.

In Catalina's behavior her quite unmistakable despair and agitation after the male's serious accident and strangely immobile recumbency were altogether no less remarkable to me than the brutal fashion in which she had previously enjoyed tormenting him. As before, expectation of the punishment she had already experienced was certainly not the chief reason for her anxiety. Furthermore, her behavior toward the little one after the first fall before she was punished had changed to clumsy exertions. Similar developments certainly occur in human children; every boy who has knocked another down in wild play has been overcome by a feeling of disquiet at the sight of the suddenly motionless body, even if he has had no experience with sickness or death. We are not dealing here with an intellectual behavior, but rather with the strong dependence of an emotional state on phenomenologically striking changes in a creature of the same species, of such a kind and along such lines as could hardly be observed in lower animals. I have previously found this type

of behavior, related to that of humans, only among chimpanzees. However, it might also be expected in primates on the next lower rung on the evolutionary ladder.

The hopes we had for the earnest, quiet little male never had time to be fulfilled. He, also, recovered from the consequences of the journey very gradually. Slowly, he began to climb and to become more mobile, but he still sought anxiously and silently to stay within himself. Accepting us, which came very easily to Catalina, was simply impossible for him, and the only cause for his mournful, honest face to become contorted with rage was any attempt to touch him. He snapped ineffectually at the hand, squeaked and whimpered, and covered his head strenuously with both hands if he was nevertheless picked up from the ground. Left alone and apparently unobserved, he seemed more content and almost comfortable, especially when in peace and quiet he made order in his surroundings, endlessly smoothing his little blanket, and so on. Altogether, he remained a true enigma, and the steady, gentle sadness of his expression became gradually frozen. I was struck by how often he yawned; his baseless anxiety also seemed remarkable to me.

After a time both animals suffered a severe intestinal disturbance with high temperature, which human newcomers to this island also contract. The female recovered very quickly, the male much more slowly. I gave a month to save this obviously valuable little animal with the remarkably human face but the physicians did not know what to advise. Finally the little one died after several days of high fever and apparently severe pain. The symptoms of anxiety were quite striking to the very end.

The death of this anthropoid caused great harm to our observations. A great deal more can be observed in a group of anthropoid apes than in a single individual, not only because the former offers more individuals for observation, but also because of the likelihood of observing greater activity in the individual. Since most zoological gardens acquire no more than one anthropoid ape of a species, the *first* disadvantage is that an ape alone is much less animated than the same animal in a group of its own kind in all the social activities and manifestations of existence that are immediately observable. For example, in direct observation of chimpanzees, the most interesting things seen can occur only in a group, things, that is, that result from the association of animals with each other in which one animal provides a stimulus for another. The introduction of a human being as a substitute for another individual of the same species never succeeds completely (although, indeed, surprisingly well at times) because reciprocal understanding, particularly of the human being by the ape, is always limited.

*Second*, however, a chief means for understanding anthropoids is lacking if one is unable to observe the behavior of several members of a species in relation to the behavior of the individual animal. For not only can the *reactions* of the others sometimes be more easily understood,

but they can also supply clues when the behavior of the animal alone was unclear. It can also happen that the behavior of one animal and the reactions of the other, that is the responsive behavior, would each by itself be ambiguous, whereas the meaning, the true essence of the interaction between the two is immediately forced upon one with observation of both together. Since we are gradually arriving at a theoretical comprehension of gestalt-formed effects and are ceasing opposition to their recognition, we should no longer be surprised that in some circumstances we are taught much more from one global *observation of the whole* than by an observation of an assemblage of parts.

*Third*, unless one has had previous experience with a number of other animals of the same species, one is constantly in danger of interpreting the qualitative behavioral spectrum (the personal characteristics) of this particular individual as behavior typical of the species, and its psychological achievement level, as measured by intelligence tests, as the average level of all such animals. If our suspicions are correct and Catalina does not achieve the highest rank of possible orang intelligence, and perhaps is also less well organized than may be possible for others of her species, we must regret all the more the loss of the other animal.

During the male's illness, he was confined apart from Catalina because I feared for him in view of her roughness and impetuosity. She showed steadily decreasing interest in him when he occasionally squatted down in front of her cage because he could not join her in the wild play that she loved. Once, indeed, I saw how she tried to raise his heavy, mournfully drooping head with a solicitous nudge under the chin, but it appeared to me to be more from curiosity than from friendliness, to judge by the expression of her face. The complete disappearance of the animal, whom she had seen only rarely toward the end, had no noticeable effect on her behavior.

She was able to enjoy playing even by herself and proved to be sufficiently high-spirited at it. For a while her sleeping blanket or a coarse sack was her favorite plaything; she dug into it and wound it around herself like a cocoon and then began to perform weird gymnastics under it, to thrust out her arms or her entire body, turn somersaults, all wrapped up in it, and so forth. The same devices, as well as her gymnastic rope, which she had ripped loose in short order, were frequently put to quite unusual uses. She laid them over wood and iron bars that crossed her cage horizontally, hung by the hands from the free ends and slid along the bar, occasionally helped by her feet. She went to work at this with great care; the crosswise suspension was done in very distinct fashion, and when the material became tattered she first remained cautiously hanging by one hand from the bar itself until the bearing strength of her contrivance was adequately tested. On the basis of continual play of this kind, one might say that Catalina achieved a degree of accomplishment never attained by any of our chimpanzees. In her play she tore

down a new rope soon after we had hung it from the strong wire mesh of the roof of her cage. A short time later, however, she drew it through the mesh in the same spot and made it usable again.

For reasons not relevant to this discussion, I was not able to test whether Catalina had actually properly suspended a rope lying on the ground, because an object fastened high up in the vicinity could be reached only by swinging on the rope. From other experiences with this animal and with chimpanzees, I consider it probable that the already familiar technique would have been applied in the sense of toolmaking if a target had to be reached.

Apart from their use as toys and tools, blankets and the like are used by the orang similarly to the way they are used by humans and chimpanzees. It can happen that the chimpanzee will fold its blanket lengthwise and twist it into the straw of its nest, thus robbing itself of a possible covering, because it no longer sees it as a blanket and uses it for a purpose for which straw is quite good enough and is abundantly available.

Yet, when a chimpanzee such as Sultan sleeps outdoors, it covers itself as completely as possible with a sack or a blanket if it is very cold. The anthropoids from Cameroon and Indo-China that seek shade, at least in the summer, whenever they can, are as sensitive to the rays in these latitudes as are we Europeans. Catalina makes use of any suitable protection to cover her neck if she finds herself in strong sunlight. If nothing is available she puts her hands over this area; the male did the same, always sitting with his hands over his neck when the sun was high. When we noticed why he did this we gave him a little blanket and he put it to immediate use. In their native habitat these anthropoids hardly dare venture out of the deep forest shadows. Perhaps their body pigmentation does not darken as rapidly there as in the summer light of the Canaries.

Catalina's favorite pastime was playing with people, of which she never tired. Such play always concluded with a friendly thrashing. She liked to swing back and forth, her head down, her feet clinging to the wire roof, and then with fearful grimaces she would aim blows at the person, or she would pull to herself the head of the person standing in front of her and then dash her own head vigorously against his or simply beat upon his with outstretched arms. On our part, we would also respond vigorously, much more roughly than was possible with the chimpanzees. With the latter, at a particular point in the proceedings, the mood might be transformed at a moment's notice into one of bitter hostility. With some, as with badly behaved children, one had the impression that they enjoyed such strife. Catalina, however, hardly ever attempted to bite, even when she was lifted from the floor by her feet, head down, and tumbled upside down into the air. She would become anxious for a moment, but she never became cranky, and she seemed totally devoid of mistrust.

In such matters there is, from all that is known about orangs, a tem-

peramental difference between them and chimpanzees that hardly has a parallel in the difference in their physical characteristics. On the other hand, she resembled the African apes a great deal in their special preference for the game of "tickle," and especially when her neck was grasped and squeezed. Once it was begun she was not at all pleased if one stopped providing this pleasure, and often took the person's hand and pressed it on the desired and expressly proffered spot. Besides the neck, a strong reaction was obtained on the lateral aspect of the rib, on the upper thighs, and over the lower abdominal surface. Later, the animal, having grown large in the meantime, began to react to squeezing of the entire lower part of the body with quite diffuse naive and childish sexuality, so that the game had to be discontinued.

The extremely pronounced reaction elicited by tickling is related to, if not identical with, that called forth in humans. Like the chimpanzee, the orang being tickled draws back the corners of its mouth and emits a little rhythmic cry that strongly resembles the laugh evoked by tickling in human beings. The muscles surrounding the affected area become tense, and the whole animal writhes as though to avoid the stimulus, while it nevertheless seeks it again at once as soon as it is actually discontinued. Catalina never repaid in kind, that is, she never tickled humans back. I do not believe that she refrained out of anxiety, as she did not shrink at all from hitting wildly in play. Probably it is pleasant to thrash, and even pleasanter to be tickled. But there is no special charm in tickling others, whereas for human beings the active role seems to be as much fun as the passive one.

Our association with Catalina continually called forth the impression that in its entire nature this creature is much nearer to Europeans than are the chimpanzees; it is less an animal than they are. This impression was not based on its intellectual achievement, in which some of the chimpanzees surely surpassed Catalina, but solely on disposition, character, and the like. If the following expressions have a meaning when applied to human beings, they have the same meaning when applied to the orang, as well as to the chimpanzee. Catalina is without doubt "finer," "more decent," "more reliable" than the African species; she is often presumptuous, even impudent and astonishingly disobedient, but coarse traits, a kind of unreliability of moods, brutal and self-indulgent emotional explosions such as are seen in chimpanzees, do not appear in this orang, and probably would not in other apes of this species. A quite sudden "physical" aversion can easily be formed toward chimpanzees that have outgrown their much more human early childhood. Catalina's manners never evoked this reaction.

The orang does not seem especially clean. It appeared truly unlovely when Catalina, as had long been her custom, again and again regurgitated the food that she had just chewed and swallowed, spat it out and with the greatest enjoyment poured it from one hand into the other and then

licked it up again. It was also not delightful when she rubbed the liquefied food that she held in her mouth into the long, beautiful hair on her arms, forming stiff, long, dirty curls.

Rarely, however, and only in very great heat, did she lick her own urine; and in distinction to the repulsive coprophagy of the chimpanzees, she always disregarded her feces, while the chimpanzees could not ever be kept from pursuing their disgusting custom all day long when we were present, despite the certainty of immediate punishment. Oddly, both orangs, in the first weeks after their arrival, were obsessed with soil as food and consumed it in great quantities.

We were first able to observe what the orang looked like and what occurred when she was really angry when, on the third day of their stay at the station, a dog came to the front gate. The female was hanging in the branches of a small tree directly above the dog, and the little male was beside the gate. As soon as they saw the dog they did not let it out of their sight. Both betrayed great agitation in their attitude and expression. Their eyelids sprang wide open, producing an unmistakably threatening facial expression, very similar to the threatening face of human beings, and they emitted loud smacking sounds from mouths thrust forward like snouts, followed occasionally and very briefly by a deep, guttural grunting not unlike that of swine. Catalina, who had already become stronger, gradually assumed a threatening posture with her whole body and gestured fiercely toward the dog. She began to shake the branches violently on which she was standing and that she was holding on to, and finally tore at and tossed the entire crown of the tree continually in the direction of the object of her animosity. All this time, the dog was 5 m away and behind the gate. The violent motion of the tree shortened that distance by only a tiny fraction.

This is one of those cases when lively emotion, certainly not of a deliberate "intellectual" nature, courses through the limbs, thus impelling external objects. Here moving of objects naturally corresponds in direction to the target of the feeling. In this way, an event that at first might be called an expressive affect can, under favorable conditions, become the direct use of a weapon. Similar statements can be made about chimpanzees, and not only in the special case of explosive anger. I am also reminded that related manifestations have been observed in human beings; the more primitive and lively the feeling in question, the more easily do such reactions occur, so that one must consider them very basic processes.

When a popular matador kills his bull in a particularly rashly bold and elegant manner, thousands of hands throw hats, fans and the like down into the arena, thus providing a way to discharge and direct the overwhelming mass enthusiasm. Whatever is in their hands that is movable is flung forth by the "emotional pressure," in its spatial sense. It is no wonder that *all* the impulses follow this basic direction simultaneous-

ly. All around, the whole audience, torn from its seats, leans over the ramparts towards its hero.

When Catalina had to be mildly punished immediately after her mistreatment of the male, she first displayed anxiety that was expressed at once, as with chimpanzees, by emptying the intestines and the bladder. But she then dared to display her anger after swiftly fleeing to her little tree, and buffeted the crown of the tree violently toward me, as she had previously done with the dog. At the same time her face became contorted into an expression of wild outrage, almost a grimace, that had a comical effect in view of her youth and frailty, and that gave her the look of a Chinese grotesque. Her agitation was so great that she came down again, stood there angrily, threw resentful looks my way from a distance, and now and then attempted a swift approach in order to hit me. Such scenes were repeated. When she had taken away food from the male she would hand it over to me quickly, without resisting, upon being lightly threatened. But immediately afterward she would again seize hold of the tree and shake it in my direction, while her outthrust mouth emitted those extraordinary smacking noises. These distinguished the orang sharply from the chimpanzee, which emits neither a similar sound nor even anything resembling the very angriest orang phonation: a dark sound deep in the throat that has the effect almost of an eructation. When Catalina was somewhat older she sometimes emitted these sounds, often in rapid succession, when she was extremely provoked.

It sounds strange enough when it is emitted by fairly large males of the species; it is all the more surprising since the usual vocalization of young orangs consists of thin, light squeaks. For all excited states *other* than anger I heard only this vocal expression, which belongs to the emotional area of apprehension and can be interpreted as such according to the rapidity and intensity of the squeaking. I have never heard an orang "howl," whereas the chimpanzee howls savagely, literally painfully to the ears. The orang's smacking sound occurs in pretended play fights, as well as in true anger, and when this activity turns out well I can sometimes induce Catalina to reply similarly by imitating the smacking sound; the deep growls, on the contrary, evidently follow only very keen, severe excitement. They give the impression of strong glottal explosions and could well be the acoustic accompaniment of a rapid succession of glottal spasms, which frequently occur also with chimpanzees in a state of overwhelming emotion, especially rage. In the African apes, however, the spasms are accompanied only by retching noises, with the tongue protruding. Phonic manifestations never occur in either anthropoid without emotional provocation; the less excitable orang is also correspondingly less frequently audible. In variety of acoustic expression it appears to be far behind the chimpanzee, but an incontestable decision can be arrived at only with observation of a group of orangs.

Often when we went at each other in play I saw Catalina brandish

sticks at me that she had picked up from the ground. She did not hold the sticks the way we do when we intend to strike, but rather the way we hold a dagger for a downward thrust. Her gestures in such instances were grotesque, only very approximately directed toward me and completely inappropriate for a serious attack. But ten days after the animal's arrival the stick was actually used this way in anger as a weapon. The attendant entered with the beloved bottle of milk and other food but did not give Catalina her portion at once, so that she became impatient and pulled and tore at the man, who meanwhile held the food up high and to her other side. As a large crate was standing on that side she climbed up on it. As the attendant stepped back, she began to shake the crate vigorously and to rock it back and forth, as she had done previously with the branches of the tree. The man moved away along a low wall against which the crate stood. Catalina, in a rage, followed him on this same wall. As he drew back from the wall into the open space, she seized a large flat stone that lay loose on top and threw it clumsily about one and a half meters directly at the attendant's feet. When he stepped back further and did not offer the food she climbed down, smacking with rage, stationed herself fiercely in front of the man, and several times shook the stone that she had just hurled, with increasingly agitated gestures of attack. Then gradually, because of the effort needed, she raised it a distance into the air, aiming forward obliquely toward her adversary's feet. After this preparation (that took some time) she let it drop, with force, because her strength did not suffice for an actual throw or thrust. The fury of the little animal stood in extremely comical contrast to its ineptitude and to the ingenuousness with which it slowly took aim for its act of violence upon the feet of the tall human being.

Should anyone express doubt that the spontaneous use of weaponry is really present here, rather than merely the expression of growing anger, I assert the following: The transition from one to the other is quite continuous. The two essential functional elements are first employment of a weapon—the use of a *thing*, not only of an organ of the body, against the enemy, and such use *upon the enemy*, with distinct and conscious spatial direction. Both appear when the emotional discharge cannot yet be described as an actual attack because it is too feeble or too inept for outward success. From this the conclusion can be drawn that, as long as the simplest conditions are met, not much more than intense emotional pressure to attain a goal is needed by anthropoid apes for primitive utilization of tools to manipulate the environment and for significant orientation in space. To understand this we must have a theory of the dynamics of emotion, of the perceptual field, of innervation, and especially of their actual relation to each other, rather than a hypothesis of special intellectual processes; for these last have little to do with the origins of emotion, perception, innervation and their relationship that differ in many respects.

Some elements of Catalina's behavior toward objects looked insightful. When she still inhabited her traveling crate we used to shove her bowl of milk through a two inch opening at the bottom, between the floor and the barred side of the crate. The straw of her shelter lay there, and one time I found the entire opening totally blocked by it. I held the bowl motionless at the opening and waited to see what would happen. Catalina looked at me for a moment and at the bowl, then suddenly seized the straw and shoved it energetically and completely aside from the place in the opening opposite the bowl, so that the bowl could go through. Later I made it a point a number of times to move the bowl to blocked up sections of the opening, and then stop short, as though at a loss. Each time Catalina made an opening for me, and always at the spot opposite the bowl. When we remember how slow-witted the chimpanzee is at clearing away obstacles, we can correctly evaluate this little achievement.

Catalina had often seen how we poured milk into a bowl from a can. One day the bowl remained in the cage and for a while served the animal as a toy. But after a while when I approached with the milk can for the next meal, she was sitting quietly in the bowl without taking any further notice of it. I used the occasion for an experiment. Outside, in front of the cage, I made pouring motions with the can. Catalina watched in surprise for a while, then suddenly seized the bowl, pulled it from under her hindquarters, shoved it through the opening and held it at the side at the correct place, under the obliquely positioned can. She did this all without a break and without hesitation starting with the abrupt beginning of the solution. What is more, she held it horizontally, although with the concavity facing downwards. This observation, made in the first days of Catalina's life at the station, is as noteworthy as the previous one. Whether she had somehow known such a situation before is no longer very important to us. I have never observed the like with a chimpanzee. There are certain problems that Catalina solves sooner than the African apes, although on the whole she is no match for Sultan, for example.

If the milk was to be drunk from a glass bottle instead of from a bowl, it frequently happened that Catalina would begin to lick the outside of the bottle at the level of the surface of the milk. Such behavior, which reveals ignorance of the remarkable characteristics of the substance called "glass" must not be confused with lack of insight into the structural characteristics of the situation.

Probably Catalina's solitude was responsible for the fact that she later developed to a very high level of perfection this preoccupation with objects, which we human beings deprecate as outright destructiveness. Since I had other tasks I soon had to discontinue preparing new gymnastic apparatus and toys for the orang because they were reduced at once to rubble or tatters. The consequences, however, were even worse, for Catalina turned to the destruction of her habitat. Since she used tools for

this, with tenacity and patience she made much greater progress than we could have wished. The side bars of her quarters rose above a low wall about 50 cm thick that was built of large undressed stones, with small stones in the interstices, and was painted and coated with lime. Catalina's breaking off bits of chalk and stone from this wall was not immediately harmful and was tolerated because of her need for busywork. But it was not long before she found that with the help of a substantial stone as a hammer the work of destruction progressed much better. From then on, for the greater part of the day, knocking and hammering was heard in her somewhat secluded area. It soon got to the point where we had to replace the wall where Catalina had worked because she could otherwise have slipped through the resulting openings. She did not strike arbitrarily and without planning at one spot or another, but was occupied with only one, or at most, two or three at a time, where original success invited a follow-up. Since we thought that Catalina would not get very far with her work without a hammer, we removed all stones from her area; but she bit and scratched at the carefully repaired wall until stones were again freed in *that* spot, and again we heard her patiently hammering.

In the meantime her skill had greatly increased. Hardly a day passed when she did not throw down half the wall at some point, and since we could not continually rebuild it at the same place, she actually did escape a number of times. Then we would find her immediately on the boundary path or among the banana plants of the surrounding farm, anxiously squeaking and, in spite of a clearly "bad conscience," innocently stretching out her hand to us still a long distance away, for she was already quite exhausted from the short journey on level ground. She could not run away, so she needed our guidance for her return. But if Catalina came to a tree or some such other place where she found herself in her "climbing element" she was far from stretching her hand out to us. Since on such forbidden outings the animal can easily be injured by human beings who are ignorant of it and fear it, we now proceeded to give the wall an exceedingly hard protective cement coating. But Catalina's technique grew with her task, and she soon went through the wall again in a single day. Since the cement bills were too high, and Catalina could suffer or cause harm on the outside, I decided to punish her somewhat severely as soon as she began again to knock down the wall. That helped not at all. The animal understood well why it was being punished, because it began to squeak and attempted to escape if we caught it in the very act, even before we threatened it; but even severe punishment hardly had a restraining effect for even a few days.

It seemed to me that such measures did not make a deep impression. Since the animal's punishment had to be kept from turning into a heavy thrashing, and since she had to be protected from a dangerous blow caused by some rapid movement, I tied her up at the scene of her offense.

Afterwards, as soon as she saw that the storm was over, without being told she would quite tranquilly stretch out her tied up hands to be released. In the next moment, even before she was entirely free, she would be chewing on a banana or a piece of bread as though nothing had happened. In the face of such behavior, revealing Catalina's entire nature, punishment soon appeared to make no sense.

I observed that the chimpanzee, in keeping with its violent character, reacts quite differently to training by means of punishment, although with similarly slight success. One must see Sultan when he is quick to bite and has earned a thrashing: boiling with rage he squats on his haunches for a long period, flashes sidewise looks of profound hatred at human beings, and cannot choke down even a bite of food until his inner agitation has slowly subsided.

When Catalina was given new quarters at the end of 1918, I, on the basis of gestalt theory, took care with complete success that this time the destruction of the foundation wall should quickly lose its charm, for Catalina turned with the same energy from the wall to the destruction of the thick wooden roof beam. Here, as is so often the case with problems, some psychological awareness is seen to be far more successful than the old mode of punishment. I had the foundation walls of her cage sunk into the ground so that their upper surface was at ground level. When the now enclosed spatial object (the wall) was no longer there, Catalina's appetite for destruction no longer had a phenomenologically satisfactory object; though digging would have been easy, it somehow did not occur to her to resume the old procedure, and she abandoned the wall, which now existed simply as a human concept.

### INTELLIGENCE TESTING OF THE ORANG

A few years earlier, Yerkes tested the intelligence of a young orang, using the same methodology as mine with chimpanzees. The results were about the same as mine. The orang fetched an otherwise unreachable object with a stick, and when the object was placed high up, it used a crate as a stool. Likewise, it also used the experimenter as a ladder, and dragged him beneath the object for this purpose. A tree served as a climbing aid and vaulting pole; and for higher projection it laid a clumped up blanket on the ground. Even in the "good mistakes," orangs and chimpanzees appear to be in accord intellectually, except that, according to Yerkes' report, the approach of the Asian apes is somewhat less positive, more diffuse, than that of intelligent chimpanzees when solving a problem correctly.

Catalina did not contribute much to an accurate determination of the limits of the orang's achievement with regard to insightful activity. Only a few times did her conduct in the experiment have the clear, sharp, unambiguous character that is known from the few findings in chim-

panzees. She compensated for this, in that she produced a number of very primitive elements again and again with amazing artlessness when insightful behavior first occurred, thus giving the observer reliable indications for a possible starting point for construction of a theory resting on the nature of these very early origins.

In almost all intelligence testing of the orang, attention must be paid to the fact that preexisting morphologic characteristics of the Asian anthropoid are different from those of the chimpanzee, and that the body structure of the former is in general less favorable for the desired performance than that of the latter. In clearly specified conditions in intelligence problems, flat, open ground is often the field of action on which the animals are supposed to set themselves, as well as actual objects (tools), in motion. This is easy for the chimpanzee, but it is somewhat difficult for the orang, which is not made for locomotion on level ground.

It is true that the orang, because of the skeletal plan and muscle connections of the *rump*, can maintain and move in an *upright* posture much better than the African ape. Only a very few chimpanzees are able to straighten the rump without pain, while the orang (or at least Catalina) easily bends backwards even beyond the vertical, and is definitely not prevented by morphologic factors in the rump and hip region from walking upright. But while the chimpanzee has to assume a rump position similar to that of its surely closest relative a step below, the baboon, it stands and moves surely, firmly, and when necessary rapidly, on hands and fingers, or, bending forward somewhat, on feet alone, because the soles are broad and are planted firmly on the ground in locomotion. In walking, the orang holds its *hands* roughly in the same way as the chimpanzee, but it walks only on the upper joints of the fingers so that the fist is closed, and less frequently on the second finger joints, which is the usual way with chimpanzees; or it walks with the flat hand open and facing down, an occasional playful style of movement in the chimpanzee. The soles of the orang's feet, on the other hand, hardly ever touch the ground while walking and standing. It places the outer edge of the sole of the foot on the ground, curls its overlong toes inward into rings and stands on this edge and on the outside of the little toe, which is bent into a ring. The large toe, a completely inward turned stump set far back like the thumbs of our hands, remains useless here. It is only too obvious that, despite the supporting hands, standing in this way is insecure, walking is slow and tiring, and both are truly stressful; 200 m at a stretch on level ground is, therefore, an arduous trek for Catalina, and she moves with marked clumsiness over even one one-hundredth of the distance. It follows that she cannot easily fetch objects over open ground.

Outline drawings of Catalina's feet, a chimpanzee's (Sultan) and those of a European are sufficient reminders of the strong distinctions that exist purely externally. On the ground, as I have described it, and chiefly in climbing, her foot operates somewhat like a hand, as an adjustable,

tightly locked ring. Since the orang's thigh can be turned toward the rump in the most improbable positions, and since, at a superficial glance the hands and feet of this species can be easily mistaken for each other, Catalina will often hang suspended in such configurations as demand special attentiveness to differentiate the limbs as here an arm, there a leg, and so on.

The chimpanzee's hand, also, gives it an advantage over the orang, since the African ape is able to move the very powerful thumb of its much more arched hand with pressure against the other fingers and so, for example, can hold and wield a stick firmly. It is true that there are individuals whose hands have an elongated, narrow structure. But their thumbs always reach forward far enough to be able to work in opposition to the other fingers; the orang's thumb, on the other hand, is located much too low on the exceedingly long hand, with its rather unfortunate structure, to be able to press firmly against the other fingers. In addition, as a result of hanging from trees, the animal's hand has almost become an adjustable clasp made of four rings. Consequently, all experiments in which sticks and the like are used become much more difficult for Catalina than for chimpanzees.

Correspondences and differences between orang and chimpanzee could best be recognized if the tests given Catalina would correspond as closely as possible in design with those previously described for the chimpanzee. For this reason the investigative conditions were selected from among related ones used earlier.

## 1.

The fact that Catalina recognized possible detours if the direct route to the goal was not accessible, and traversed them at once by moving her own body, required no special experimental proof. Whether the obstacle was something on an otherwise clear path presenting a possible detour, or whether the goal was located beyond an open, impassable air space, so that success could be attained only by clambering sidewise over certain objects, made no special difference to Catalina, any more than to the chimpanzees. The detour was taken without delay, and, as with the African ape, it was only a matter of preventing the easiest procedure in order to focus on other solutions of the problem. *Here* indeed there appeared a slight distinction between the two primates: It is perhaps more difficult to dissuade the orang from a dearly wished for behavior by forbidding it, as in the following example. Blocking or punishment tend to be misinterpreted by the orang as a general prohibition, more than by the chimpanzee. When she was forbidden to climb a detour, Catalina reacted as though she were forbidden altogether to try to reach the goal. Several such interventions simply impressed her as hostility, and a scolding. She then abandoned any effort to reach the goal and in

her behavior clearly expressed anxiety toward the angry human. The chimpanzees, it seems to me, understand more accurately, in general and in detail, what I want them to do or not do; and since it is the more limited ones among them, for example, Rana, who interpret light prohibitions of restricted scope as generalities or even as direct attacks, I do not see this as a promising sign of intelligence in Catalina's behavior.

## 2.

A wire one and one-half meters long with a piece of bread at the end ran along the ground from the bars of the animal's cage. After Catalina saw the bread, she grasped the end of the wire near her and began to pull, looking out at the bread. The poorly fastened object shortly fell out of the wire loop, and Catalina immediately let go of the wire. A day later the bread objective was attached to a string one meter in length that reached to a spot directly below the bars of the cage. Since the lower end of the bars and the floor of the cage were some 30 cm above the ground on a base of stones, the free end of the string was not visible from the interior of the cage, and farther out the gray string did not stand out from the dust and chips of wood on the ground. Although Catalina noticed the bread, she made no attempt to reach it. But when the experimenter raised the objective about 10 cm so that a similar length of bread was clearly visible in the open space, her glance traveled along the distance from the objective to the cage, she slowly stretched her arm out toward the area of the ground (invisible to her) where the string was running, groped about a bit till she found it and then drew up the string and the objective. The bread was a longish loaf that at first rested in her hand, transverse to the bars of the cage. She brought it through them with a correct rotation, without preliminary trial and error. The delay in the *commencement* of the solution could only have been caused by Catalina's not having noticed the inconspicuous string at first.

## 3.

On the ground, a short distance from the cage, lay a stick, to which the animal nonetheless paid no attention. When I approached her with a piece of bread Catalina began to whimper, stretched out her arm toward me, grasped my arm and broke off as much of the bread as she could hold. While I put the remainder outside beyond her reach, she settled down on her blanket, at the bars. She ate a while, constantly looking over toward the goal-object (bread) and the distance to it. She put the bread away suddenly, got up, grasped the blanket she was sitting on, quietly and carefully crammed the blanket between two bars of the cage, letting it open out, and flung it repeatedly toward the goal, letting it open out completely each time, until the cloth fell in the right way over

the bread. Now the nearest corner was within reach, and Catalina drew the whole blanket in slowly and carefully, searching a while until she found the objective among the folds.

When the experiment was repeated, Catalina was sitting at the bars when I laid the objective down outside, and her blanket lay 2 m behind her in the cage. She fetched it, crammed it through the bars and then tried vainly to pull the goal toward her by means of the blanket. The parts of the blanket that fell over the bread were too light in weight, so that as soon as Catalina pulled, the cloth slid off without taking the objective with it. But when, at the third try, she very carefully bunched the blanket into a ball and with supplementary thrusts and flings heaped it properly on top of the goal, she solved the problem with complete success. The animal did not behave as though this were the first time. Since few things are as functionally familiar as its blanket to an ape living in cramped quarters, and since it often happens that remnants of food or the like fall from the cage to the outside out of arm's reach, it is very possible that the opportunity arises for it to have already invented the method before the problem was presented by the experimenter.

#### 4.

In the following necessarily detailed description, it is not a question of an opportunistic "invention," but rather an example of a specific dynamic force in a situation with strong emotional content, in which this dynamic force could be clearly revealed only by reason of this particular intelligence test. I observed the animal's behavior very closely during the origination and further development of this achievement because it soon became evident that Catalina's inventions were those also observed in chimpanzees and children. Her behavior could be seen and understood with unusual clarity, as it was in the earlier experiences with stacking crates.

The way in which Catalina finally arrived at the utilization of the stick was quite startling. It deviated altogether from the behavior of the chimpanzee in the same situation. Before the experiment (6/19/16) the blanket was taken away and the stick was at the back of the cage, half hidden under the animal's bed of straw. When the objective was laid down outside the cage Catalina came to the bars, looked out, then turned to the straw bed where the blanket was to be found at other times, looked out again, looked again at the corner where the blanket was now missing, and so forth, many times over and over again. Finally, she fetched a piece of dried banana leaf that could be seen in the straw of the bedding and threw it at the objective, exactly as she had done before with the blanket. Unfortunately, the leaf was then not within reach, so that the objective could not be pulled in. Here it must be noted that amid the movable contents of Catalina's cage the banana leaf indeed most resembled the *blanket* in approximate appearance and approximate functional char-

acteristics. Catalina did not visually investigate both objects, just as Koko did not when he made a substitution for the stick. A long time elapsed, until finally in the clearly defined situation and with the continuing need that was not satisfied by the blanket as a tool, the banana leaf took on a functional significance approximating the blanket in its functional sense. It was then fetched, and employed, but, indeed, without success.

If we do not shrink from applying to anthropoids a term from the new psychology of human thinking, we can say, as we often have with regard to chimpanzees, that we have here "determined abstraction." The expression must not be misunderstood. As with the so-called *positive* abstraction of human beings, it is not achieved through active disregard of the differentiating characteristics of the banana leaf and the blanket. The person who wishes to drive a nail into the wall quickly and has no hammer at hand grasps the boot with a solid heel, the boot tree, the clothes brush, or, outdoors, a stone or heavy board, and hammers with an alternative despite the phenomenal characteristics differentiating it from a hammer. It can happen, moreover, both with human beings and with gifted anthropoids, certainly with Sultan, that given the need for an implement, the objects that are at hand are scanned under the stress of the situation until a functionally desirable one becomes apparent to the scanning eye, but an active search is not required. It can at times be observed how a bewildered and discouraged human being or ape suddenly will, with an altogether accidental glance, perceive an object with the desired functional property. The word "determined" did not signify the action of a particular decision in this connection, and it certainly does not for the ape. But when, for example, a hungry anthropoid sees a banana outside the bar, this situation, or complex of conditions that are present, at once produces potentials in the animal that markedly influence temporally- or spatially-related perception and behavior in a specific sense. The activity that persists until the resolution of these potentials created by the situation is designated "deliberate." That it is not only evoked by the situation, but also as a rule, *acts upon it*, to a great extent produces the impression of striving toward the goal, which some people with great confidence attribute to the search as well as to all organic happenings, whereas others believe with equal confidence, on more general grounds, that such an origin should be represented as being only apparent and indirect. It will be demonstrated later, purely on the basis of natural science, that organized [gestalted] processes in systems must universally follow a significant and goal-adapted course according to the species.

Directive tendencies arising out of a strongly felt situation can manifest themselves in very different outcomes. As we will demonstrate, the outcomes and the strongly felt situation are equivalent in meaning in gestalt theory. If a human or an anthropoid once used a certain tool that is now missing, determination operates in such a way that any similar objects are easily seen as substitutes with regard to the function of this tool.

Self-observation seems to show that in these situations nothing has

been taken away from the objects, nor has something simply been added, but the gestalt perception occurs with a specific mode and emphasis approximating the missing functional value. In such a case it is better to speak of "determined perception or exclusion" than of "determined abstraction."

After the blanket had been exchanged for a stick in another experiment, something visually very different from the stick was employed in the same way, just as in the case of Koko. Catalina threw stalks of straw, then a whole handful of straw at the objective, and finally fetched a large bundle of straw from the back. She flung this too and heaped it up as well as she could over the objective, exactly as before with the blanket. Here the effort was not successful, for the stalks that she finally reached with her arm became separated from the loose heap of straw as soon as she pulled them. Their weight was too low and they slid away from the objective. Finally, when she flung it out too zealously the straw was out of reach of her hand. The same thing happened with a new and larger bundle of straw. When failure became plain, new attempts ensued, one after the other, until at length the objective disappeared completely under the straw. In the meantime, the situation had changed, since outside there was a lofty tower of straw atop the buried objective, while at the back of the cage the stick on the floor was quite free from straw. Only a thin wisp of straw, lay here or there in the cage. The heap of straw, which could now be only an annoyance, was removed by the experimenter. Now, when Catalina flung out the bits of straw, her somewhat listless behavior gave more the impression of aiming scatter shots at the objective; this is likewise seen in chimpanzees as a kind of expression of feeling toward the objective. Soon this activity with the objective also came to an end, and Catalina played in her cage. She remained completely quiet and indifferent. *The stick had not become the blanket.*

The operative forces were reinforced by duplication of the objective, but Catalina gathered up only bits of straw that can be grasped through the bars and flung them at the objective. Then she sat down in back in a corner of the cage and chewed on the last remnants of straw. When her glance fell on the stick she picked it up, played with it quietly, gnawed a little on one end, and finally let it fall disregarded. Some ten minutes later she let fly a few stalks toward the objective. Immediately afterward she again squatted in her corner and played contentedly with the stick, the last thing she had left to play with. Again she let it drop indifferently and proceeded toward the bars, stopping halfway there, looked about, seized the stick and brought it back to the bars. She then gestured through them in the direction of the objective and threw the stick at it, out of reach. Then she threw a few more stalks, next a small block of wood, and finally sat again indifferently in the corner.

I would like to observe here that from the first moment of her bafflement her behavior followed a single, unbroken chain of events. The stick

was not brought to the bars accidentally. This time it was *grasped as a tool*. But as what sort of tool? The way in which Catalina impelled it through the bars at the objective, namely, as we would hold a dagger, does not furnish an explanation, for she always held sticks in this fashion. But the way in which she *threw* it outside gave rise to the involuntary suspicion that the stick could have been intended *as a last and least effective substitute for the blanket*, unless this gesture can be interpreted as the expression of an immediate wish or even of anger. In any case, I did not have the impression during this incident that Catalina was behaving as though it were a completely new and significant discovery. What followed enlightened us regarding the sense in which she actually used the stick.

While Catalina withdrew unconcernedly to her corner, the stick was placed outside between the objective and the bars, parallel with the latter. From its corner the animal saw neither this action nor the stick in its new position. After a while she came to the bars, when she did in fact pick the stick up, but only in order to throw it toward the objective, clearly without any serious intention, and then again left the scene. I now laid the stick down within reach, in front of a side section at one end of the bars. The objective lay opposite the center of the bars. When Catalina accidentally noticed it later, she grasped it, bit one end in a somewhat unusual, but not angry, fashion, directed it through the bars, this time with better positioning so that it pointed toward the objective rather than downward, and finally, from the corner of the bars where it had been lying, threw the stick again at the objective. No gesture could say more clearly, "Stupid, useless thing!"

Two more throws of the stick had the same outcome, but the next time Catalina kept it in her hand and reached with its farther end for the objective. One might conclude from this that the correct method for the use of the stick had been arrived at. Catalina's hand remained half open; her motions were uncertain; the tool was simply *placed* over the objective to no avail, then was let fall on it and finally was more or less simply thrown, so that gentle pulling left the objective lying undisturbed. When this procedure continued for some time, it could be clearly determined from the manner of Catalina's movements that she was using the stick functionally only as a sort of *blanket*. The stick, bearing down with its own *weight* on the objective, was supposed to pull it in. Strangely, the different nature of this tool, which was much more appropriate for the solution of the problem, did not lead at all directly to its actual employment, during which the end of the stick received a component of pressure from the arm. The other quality of the stick, rigidity and potential for transmission of force, was thus utilized for a different function.

Chimpanzees are also maladroit in making the transition from one kind of tool utilization to another when it is demanded by a differently formed tool or a somewhat altered situation. Thus we saw Grande, who

had learned to use crates as stools, first using a ladder as a "poor kind of crate." Rana knew how to fetch things by raking them in with a stick; at first she used it as a jumping-pole, but could not succeed with this method when faced with an objective located at a height. Even if she employed the stick *only* for knocking objectives down, and if it was actually grasped for a *second* and raised correctly, as was required for this function, her handling of the stick nevertheless changed back at once to the jumping pole method.

I do not believe, however, that such examples are to be equated with the complete lack of understanding that Catalina displayed at first. Here we have a most particular lack of naive knowledge of physics, such as I have never seen in chimpanzees. A well-coordinated chimpanzee (such as Nueva and Chica) masters the use of the stick after very brief practice. Handling of sticks, so obvious and familiar to chimpanzees and human children, must hold some component that is not appropriate to the organization of the orang being observed here. This was seen at the beginning in the very odd and highly impractical grasping of the stick as though it were a dagger. It was seen particularly clearly when Catalina handled the stick with some disdain for so long a time. The stick had much value for the chimpanzee; Catalina actually rated bundles of straw much higher. It seems to me that this is to be explained not simply as the aftereffect of the now firmly established function of the blanket, for which the stick was indeed a poor substitute; but, rather, by the fact that for the orang the use of the stick that is so obvious to us, was truly unnatural, and at the beginning could present only the remotest possibility. Thus, the stick was used in the end, and without great expectation, as a substitute for the blanket.

Catalina did not care for the stick at all. She gathered pieces of wood and straw from the floor in front of the bars into a bundle and threw it at the objective. She then immediately picked up the stick again and tossed it out irritably and blindly. Since its particular utilization *as a tool* had already occurred, it was returned to her after a few minutes during which she calmed down. She picked it up, aimed it at the objective, and made a more serious effort to draw it in correctly.

Now an element of urgency, at first feeble, then rapidly increasing, was observed; the objective was actually moved and very gradually came almost within reach. This went on for a long time. Then Catalina tired and finally tossed the stick aside in vexation. It was returned to her and she made another attempt with it. But the longer she tried, the more she considered this thing, this stick, totally useless and did not pick it up again when it was laid down within reach. Since the difficulty was due partly to the unevenness of the ground, the objective was placed nearer on a level spot. Thus encouraged, Catalina went to work once more and was able at length to reach the objective with her hand, after

she pulled it in about 5 cm with the stick. Just an hour had passed since the inception of the experiment, with the banana leaf as the "blanket."

The significant part of the hoped for achievement was attained with the appearance of the urgency factor. At the same time, from the details of Catalina's procedure, the basis of her difficulty in discovering the functional value of the stick, which seemed so natural to us, became clear. The modes of *handling* and *grasping* that humans and chimpanzees use at once or very soon in the same situation, and without which the stick can hardly be conceived as a tool for pulling things in, was alien to Catalina. When *she* took hold of a stick her long, ringlike fingers curled tightly around the stick *as though around the branch of a tree*. The stick was held downward like a dagger or upward like a saber with the longer edge facing upwards. In any event it was held perpendicular to the position of the arm and transverse to the fingers, which displayed powerful strength in this position.

On the other hand, when Catalina grasped the stick in more or less the same way as humans and chimpanzees, and, with one end in her hand, she wished to touch the objective with the other end, then her hand and arm were in a most uncomfortable and unaccustomed position in which she was able to display only feeble strength. She seemed indeed to be able to aim the stick in the required direction, extending the arm while holding the hand facing *upward* and clasping the stick as tightly as she could with her very long fingers. At the same time the little thumb in back simply stood up by itself unused; counterpressure from this source was totally absent. Whoever has tried to pull in a banana over uneven ground, holding a stick in this position, will not need to be convinced of the difficulty. Our thumb is a very important factor in the process of transmitting pressure to the distal end of the stick; Catalina, whose thumb could in no way be compared to the human thumb, obviously was unable in her earlier life to acquire any practice or skill in this type of grip and in the handling of things that can be reached easily only with adequate development of that organ, unaided by a tool.

In connection with this, one has the impression that the neural organization of Catalina's arm and hand required for actual use of the stick appeared in her as a new motor function. When, on her part, Rana began to learn the employment of sticks in the same way, she also found it difficult to discover the right way to grasp them. I had the impression that her difficulty was due to insufficient insight. But I believe that in Catalina the slow development of the use of the stick must be attributed for the most part to her structural predisposition, that is her biologic, neuromuscular type, in a more external sense. This can be known more definitely only after observation of a larger number of orangs.

Catalina grasped the stick sometimes with her right hand, sometimes with her left. Every deliberate attempt to use it, however, was made with

the *right* hand almost without any exception. In other respects also, Catalina's responses to concrete things are much like those of a *right-handed* human. The little male unfortunately died before it could be determined with any certainty if he favored one or the other limb or side of his body.

I have mentioned that Catalina sometimes carried the stick to her mouth and bit it before she sent it out through the bars. If she did not succeed in reaching the objective with the end of the stick, her impatience produced not only surly and irritable gestures, with corresponding facial expressions, but she also suddenly drew back the stick with growing dissatisfaction, brought the distal end to her mouth, bit it quickly and sent it out again. We see what this means a little further on.

## 5.

A test of whether Catalina understood the use of the rope in the same way as the chimpanzees turned out a little differently from our expectations. The goal-object and the rope hung from the wire roof of the area some 2 m apart, while laterally, at about the height of the goal-object and of the roof of Catalina's cage, an iron rod ran horizontally through the space. The iron rod was too far away for its presence to interfere with the experiment. [June, 1916]

After Catalina approached and looked over the situation she went straight to the rope hanging there but did not position herself toward the goal-object, as the chimpanzee would have done. Instead, she climbed up the wall of the house with the end of the rope, clasped the iron rod with the toes of one foot, and grasped the rope at about the same height with the other foot. Then, as one foot grasped the rope further up, and the other reached backwards to hold on to the edge of the roof of the cage, she let herself sink down towards the goal-object. Thus she, too, reached it. I had underestimated the length of Catalina's arms.

The solution made clear that the rope was seen to have a functional value in the situation. If Catalina did not use it simply to jump down, it must again have been due partly to her body structure. Most of all, she did not care much to move her body with great speed. She altogether avoided projecting it with a powerful impetus like a human gymnast or like a chimpanzee, just as she never executed a true leap. She was a good gymnast, but almost always it was the tenacious *strength* of the rings she made with her fingers and toes and the fantastic rotatability of her ball-and-socket joints that performed the important work and guaranteed security, while the benefits from the great store of temporary energy derived from the motion of the body mass remained unused. This was the reason, furthermore, that neither her hands nor her feet (long, narrow rings of muscle) were fit for striking the ground, or from slowing down from great speed; she would consequently have been exposed to pain and

injury if her body were subjected to activity that was too intense. The complete solution was reached by a detour method. Catalina brought the rope laterally to the point that was nearest to the objective. Whether in the process she had any clear "concept" of how she would use the rope was highly questionable. Rather, the impression emerged, that at the beginning it was a matter of a somewhat confused accumulation of methods, such as is already seen in chimpanzees. This time, however, success that would not have been possible by another means was attained in this way.

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The experiments described thus far took place in the first weeks, and some in the first days, after Catalina's arrival. I continued to offer her the opportunity of discovering the use of a crate as a stool with which to obtain an elevated object, but her behavior did not show any inclination for such a procedure. Since it could be assumed from our previous experiences that she was still somewhat young for such expectations, and in order that none of the specifically youthful features seen in the course of the tests would confound Catalina's achievements that were typical of orangs, the experiments were discontinued.

## 6.

A half year later further observations were conducted of Catalina's remarkable use of the stick. For this purpose, the blanket was removed from the cage and the stick was left lying in the background near the bed of straw. Outside, in front of the bars, on the ground, a tabletop was placed so that the goal-object could be moved more easily and surely than before on the uneven, stony earth. After Catalina had caught sight of the goal-object she came to the bars but turned back immediately, stared fixedly for a long time at the stick and the straw, and then fetched the *stick*, without heeding the straw. Now the following could be noted concerning the use of the stick:

- a) Catalina handled the stick with the right hand, without exception.
- b) Her procedure was still extremely unskilled, but nevertheless better defined than before, especially in that the *pressure* was always exerted on the stick. The impression no longer arose that the stick, like the blanket, was supposed to function by its *weight* alone. In another advance, Catalina now held and guided her tool overhand; but since the little thumb at the rear of her hand hardly ever touched the stick, she still did not succeed in transferring a sufficient amount of pressure directly to the *end of the stick* and to the goal-object. Then, in order to exert enough force on the latter, she strove constantly to push the *entire* stick downward from her somewhat elevated position. In her intense

preoccupation with this task, she was less able to avoid a difficulty that also causes trouble for chimpanzees and human children the first few times they use the stick. The most *natural* movement of the extended arm transmitting pressure to the end of the stick is not suited for drawing the goal-object to the ape in a straight line. Instead, it will sweep the stick around in a circle with the shoulder as the fulcrum. Although animals, including Catalina, try hard from the beginning to draw the goal-object straight in, an unintended component operates in the former direction in beginners with untrained muscles, and so makes it possible for the goal-object to bounce to the side.

c) When this happened, Catalina suddenly found herself *diagonally* across from the objective. Then she proceeded along the bars with her stick to the spot directly opposite the new location of the object and labored on from this position. She did not work by trial and error, but at once directed the stick through exactly the same space between the bars as a right-handed human being would have done. In general, she showed complete comprehension of the distances in this situation and of how they varied during the experiment. If she had at first grasped the stick too close to the middle, and this was not comfortable, she immediately set the far end on the ground and moved her hand to the near end of the implement so that its useful length was increased. When the objective lay nearby she liked to use a shorter stick that happened to be within reach outside, because the long stick was likely to hit backward against the frame of the bars and impede her movements. As soon, however, as a new object was put down at a greater distance, she seized the long stick, replacing it again with the shorter one whenever the same nuisance recurred. The length of her own arm was also taken well into account. Even the more talented chimpanzees, in their great eagerness to use the stick, rake about somewhat farther or nearer with it than is necessary. But only once, in the twenty trials with the stick, did Catalina use it with a greater length than was absolutely required. She did not make another attempt with it, but just let it fall when her arm was seen to be quite long enough. When Catalina gave up her vain attempts to reach a far distant object because her tired arm no longer functioned dependably, she always resumed her work immediately, undaunted, if the goal-object was moved nearer.

d) As with chimpanzees, one of the most significant characteristics of the procedure was the precision with which repeated, small changes in circumstances led to corresponding changes in tactics. Thus, at critical moments, e.g., in an unstable position of the goal-object, her movements suddenly became slow and cautious as when she gently nudged the goal-object because it had gotten into an unfavorable situation. Then, when the object went into a groove in the board that ran directly toward Catalina, she began energetic, rapid movements, since with such "guidance" the goal-object could no longer bounce aside, and further caution was unnecessary.

e) If the work was not going well and natural impatience appeared, Catalina, as did the chimpanzees, produced sudden new behaviors, the fundamental significance of which should not be underestimated, simply because they were extremely primitive and generally impractical and unsuccessful. Catalina had at first ignored the straw, but after some time, when she accomplished very little with her bungling manipulation of the stick, she suddenly gathered the straw into a bundle, took it *together with the stick* in her right hand and reached out toward the goal-object with the *augmented* implement. The straw was nowhere near reaching the ground. Immediately afterward she hit upon a similar attempt to improve the tool simply by *augmentation*, as I had reported earlier of Chica, during the first days of her stick experiments. Catalina added the long stick to the short one, clamped them together with her right hand and hunted about with the improved tool. As before with Chica, the shorter stick did not even reach the end of the long one, and thus, when used, certainly did not reach the ground.

These are processes lying deep in the nature of the earliest dawn of intelligence. They are not an idiosyncrasy of particular individuals or species of anthropoid. Tschego also first pressed a short stick to her blanket with her thumb, when she did not succeed in whipping the goal-object toward herself with the blanket alone. Continued swatting the blanket with the stick was disadvantageous in practice, since she had to take a great deal of trouble to keep the thumb pressed on the stick and could, therefore, in no way thrust about as vigorously as before. The same clumsy, heavy animal allowed herself to be lured one day into jumping with a stick for an elevated object. When this miscarried disastrously, she took two climbing poles, one for each foot, and plunged helplessly to the ground when she tried to ascend with both feet at the same time.

Another manipulation of an unuseful tool confirms and completes what has already been said. Like the chimpanzee, Catalina liked to chew a little on the stick before using it. It was also seen that she drew it back again and bit at it somewhat more energetically when it, actually she herself mostly, had not performed well. This might be seen as diffuse expressive movement if Catalina had bitten at random, regardless of which part of the stick had vexingly missed the mark. This was not the case. If the stick constantly slipped away from the object without pulling it along, it was drawn back, and the incompetent, that is, the *outer*, end, was belabored with the teeth. If, on the other hand, the difficulty was due to the fact that when the stick was being manipulated closer to the goal-object, and repeatedly struck the wall of the cage or the frame of the bars behind it, it was also pulled back. But now, the *back* end, the bad spot, was the one that was bitten.

Suppose now that this same stick sprouts transverse branches, and that these cause difficulty in directing the stick through the bars or pushing it through a tube. The angry biting will occur at the exact location

of the bad spot as the emotion begetting object. The branches will be bitten off, and we have a perfect case of tool production, in the sense defined earlier. It is a matter of very little importance whether one tends *still* to speak of an expression of emotion in exact spatial orientation with respect to the situation, or *already* of an attempt at tool improvement. Rather, what is more important is the insight that the use of things as tools (as weapons, for example) as well as, necessarily, the first rudimentary *alteration* of these things, arises directly from the emotional dynamic force of the specific situation. Further, *the most general and basic characteristic of adjusted spatial orientation* in these processes is also determined by the same primary dynamic force.

It seems to me to be a sound research principle always to expect expressions of the nervous system's most primitive dynamic force when intense emotions, as is their wont, make inoperative the "prettier" accomplishments of the most subtle kind. One sees such examples constantly, and one finds that the more primitive primate "stitches twice" or more, not because of clever know-how or "experience" that it "holds better," but primarily because the naive dynamic force of a strongly felt situation and a nonspecific increasing emotional pressure simply attract the "problem solving material" and allow it to persist. If this behavior is guided by growing insight, it can have a practical outcome, such as "double stitching" in the literal sense. But the notion that corresponding "experience" is required for the first *appearance* of such phenomena is one of the numerous false assumptions of association-psychology theorizing. If the axe does not penetrate the wood properly at the first blow, one does not strike harder a second time because of "earlier experience" with regard to the connection between force and changed effect.

f) If an obscure impulse is the source of such acts, continuing failures to obtain the goal-object lead in the end to behavior that is completely futile and surely not even intended to be effective, as we have seen earlier in the chimpanzees. When neither one nor two sticks, nor a stick augmented with straw is of any use, Catalina falls back on totally diffuse procedures that are above all directed only at the goal-object. In the end, in a confusion of straw and sticks, she makes blind motions toward and over the object until finally a general flinging about ensues, and the object disappears under a heap of straw and wood. Previously, before he discovered the double stick method, the unhappy Sultan guided one tube together with another one in the direction of the goal-object until he pushed the object forward. Similarly, there are people who prefer to harm the object of their desires, and fight it with might and main, rather than give up all connection with it and let the entire matter come to nothing. What is left then is the pure dynamic, emotion directed toward a surviving connection. The last remaining tendency is to at least keep alive the connection between oneself and the goal-object. What an excessive distortion of nature is offered by those who insist that the behavior

of higher organisms is explained only as being the result of the selection of useful associations (experiences)! Such philistinism cannot be found anywhere—certainly not in the world of anthropoid apes.

Repetitions during the following days changed the general picture of Catalina's behavior very little. It took a while each time before she started the *first* trial of the day. She looked fixedly at the stick for a long time, before she seemed to actively grasp its functional value and then took it up. Again, she handled the stick with her right hand, only seldom with her left, and then only for a moment. She then at once put it again into her right hand. Her movements became more skillful from day to day, but they were far from showing the short, steep learning curve exhibited by most chimpanzees when they optimize the use of tools in the same procedure. While Catalina in the beginning laid the stick on the object without any pressure, either as a holdover from the use of a blanket, or because she was unable to do it better, now with gradually more confident management of the stick in the appropriate manner, that is, by putting pressure on the object, the force she applied increased far beyond necessity. The more effort Catalina exerted to be truly successful with the stick, the more did her zeal bring about the spread of innervation of all the muscles of the arm that pressed the stick down, until at length the limb began to tremble.

This, again is an example of how the primary dynamic of zealous effort to solve a problem first responds to difficulties with an increase of purely quantitative force, even though the matter at hand demands more delicate and precise coordination with regard to the existing conditions. The simple use of more tools or many methods at the same time, *in the beginning* without regard to their practical appropriateness, was in fact a further expression of this general rule. For the third rule, which has just been formulated, we have an exact analogue in the cramped straining of the muscles of a child's hand in its first eager attempts to write, and in the spread of innervation of the arm and wrist of the beginning piano student. Additionally, in the anthropoid, as well as in the human, there is also a tendency for *amplification* of the innervation during this kind of behavior. Not only do many muscles of the arm move into a too strong and rather unnecessary excitation, but distant pairs of muscles are easily stimulated as, for example, those of the mouth, that gradually act in concert with the dominant dynamic force.

It seemed most remarkable to me that even after numerous repetitions of the use of the stick a noticeable length of time elapsed before the stick, lying in the *background* and therefore invisible to Catalina as she looked outside toward the goal-object, was finally recognized for its functional value when Catalina turned to the rear. Only as a result of repetition of the experiment under almost the same conditions could she acquire the habit of turning toward the rear after her first overview of the situation; but then she looked fixedly into the corner for a while, and actually at

the stick, before the sight of it moved her to activity. When I tested her in other surroundings, with other bars this delay was even more noticeable. It was found that a stick that had already been employed overzealously on the same day, and that had been laid 2 m further back on the ground some time before the beginning of a repetition of the experiment, appeared to her at first not to be present when the experiment started by putting the goal-object outside. Instead, the most useless slivers of wood or tendrils of vine were grasped, which had the advantage of lying in the same or almost the same field of vision as the goal-object. The same thing could be observed even when Catalina looked back directly at the stick, immediately before the experiment. In such a situation, it was sufficient that I touched the stick during the experiment to recall its use to Catalina. The general basis of this effect of the geometry of the situation, well-known with regard to chimpanzees, will be clearly discernible at once.

The presence of the *bars* between Catalina and her field of action led to two phenomena of interest. Once, when the object bounced to the side, she changed her position at once to correspond exactly with the object's new location. However, as soon as a change in position to her *left* became necessary she did not take back the stick through the bars before moving her body, but put it into her left hand, grasping it through the next interval between the bars. At this point, she passed the stick from one hand to the other, constantly taking hold of it through the next further interval, bringing herself, inside the bars, and the stick, outside the bars, together to the desired spot. (Compare the same procedure by chimpanzees, with a rope.)

Then something remarkable happened. When the stick lay in the left hand, the right hand was supposed to draw back through the bars and take the stick again through the next space to the left with a simultaneous movement of the entire body. This did not happen. Scarcely was the stick in the left hand than the right hand grasped it again without changing the space in the grating that it was in. Catalina wished to shift again to the left; the same thing happened once more, and then a whole series of times, one after the other, so that an impression of total helplessness and confusion ensued, while the stick travelled endlessly back and forth, between right and left. Catalina was plainly beside herself until the battle of the hands came to an end. Since nothing else of this sort ever occurred, the most likely explanation must be that Catalina, starting a new and somewhat advanced and complicated procedure, would always drop back into a different and very familiar one.

In view of her decided right-handedness, the transfer of the stick to the right hand after it had been placed in the left one *in the situation at the bars, facing the goal-object*, was a totally automatic event. In the act of carrying out her more highly advanced intention, Catalina created the conditions for takeover of a clearly greatly persisting automatism

when she grasped the stick for an instant with her left hand. It was already returned to the right hand before that hand could be withdrawn and shifted leftward. Her attention throughout was directed to the goal-object outside. The process was thus determined by the *goal*. Short circuit!

Some similarity to this occurrence appears in the chimpanzees in the detour box experiment when they shift into the "natural," that is, the biologically primary direction of movement, even after the higher movement in the direction required, i.e., 180° away from the animal, sideways and then to the animal, to solve the problem had already begun. Another example is the unusual conduct of the chimpanzee sitting in high grasses, carrying each new blade of grass to its mouth; then it diverts the arm from its path to the mouth and slips back into the characteristic motions specific to nest building. In the last two cases, and similar to the first one, biologically very deep-seated impulses have a propensity to interrupt other impulses to act, and to divert them, either permanently or for the moment, as soon as the apposite "critical" circumstances present themselves. This lies a bit within the realm of behavior induced by association. Even though the chimpanzee's nest building and the primary fetching of an object to itself certainly do not originate in experience, it must surely be conceded that pure association can also bring about serious interruption in the most highly advanced and intelligent behavior. The chimpanzee's crude absurdities due to habituation bear sufficient witness to this, on the one hand, and John Locke's observations of human beings also confirm it, on the other hand. In order for such a thing to become possible, a condition must indeed be satisfied in the primates in question; this will be discussed later. The notion of explaining the most highly insightful demeanor and behavior conversely in terms of chains of associations due to habituation is much too audacious, and departs much too drastically from the immediately observable character of such matters of natural experience, to possibly occur to anyone in a naive, early and free flowing stage of psychological thinking.

In addition, the bars presented a problem in themselves because of their configuration, if the stick or some other object was to be shoved through them and was not from the start in suitable orientation with respect to that configuration. Again, just as with the chimpanzees, Catalina could be seen, one at a time, taking the required position with a rapid and quite accurate pivoting movement and another time, pressing against the bars with the stick in her hand in agitated disorganization. That both behaviors occurred is as certain as that they both looked different enough to be immediately noticeable as phases of quite distinct character, one directly following the other, during a single act when Catalina made the effort to put the stick through the bars. As may be observed in African chimpanzees and in humans, the effort indeed becomes more vigorous with rapidly growing emotion and great excitement.

At the same time, it becomes less structured, until only a furious pounding along the general lines of the original intention remains. Feelings indeed have the effect of forces from which the dynamic impulse toward the goal-object proceeds and is maintained. When they continue beyond a certain measure, they produce a byproduct having an effect that is harmful to the gestalt in the extreme. In rage, the orientation of body movements in space occurs only along the simplest and crudest lines. They are, therefore, rightly called "blind."

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The behavior of the animal observed here obliges me to emphasize that a primary dynamic force is once again demonstrated in the following detailed report of Catalina's behavior in the last two tests given after the above tests were discontinued.

(5/1/17) The cage in which Catalina performed this test had wide spaces between the bars. Inside, Catalina was on the same level as the goal-object, which was situated outside on entirely smooth sand. Near Catalina, in the wall at her left, was a door through which it would be possible to go outside and around the corner to reach the goal-object. Long before the time of the experiment, a rigid tube of reed was laid on the floor 2 m behind the bars. When a piece of fruit was laid on the ground out of arm's reach, Catalina, who was squatting at the bars, for some time ignored the tool behind her, but instead at once took a handful of sand from the ground in front of her and quietly threw it at the object. Immediately thereafter she took a second handful. Looking around, she noticed a heavy nail projecting from a beam and attempted in vain to pull it out of the wood. This behavior, in obvious conjunction with the previous behavior, was undoubtedly an attempt to use the nail as a tool (a stick). When the nail did not come free she abandoned it; her glance fell upon the door, and she got up at once in order to open it with heavy pressure. When the door did not give way, Catalina's glance wandered anew until it came to rest on the tube, and remained frozen there for a longish time. Finally she brought the tube to herself and used it as a stick with some skill and with consequent success.

In a repetition in which the object was too far away and could not be reached easily, Catalina finally drew the tube back several times, bit the useless point of the tool agitatedly and blindly, ending by splitting it apart. The tube was thrust between the bars of the cage with correct and rapid twists as long as Catalina remained calm, that is, at the beginning. The more exasperated she became, when the biting began the more blindly was the stick, or what remained of it, rammed against the bars when it was thrust through or pulled back. When the tube was completely shattered and its splinters were much too short to be useful, Catalina collected several of them, laid them together and reached out with them.

12/1/17. When a piece of fruit was laid down far out in front of the same bars, Catalina at first found only a small piece of wood behind her. This was obviously so inadequate that when she reached out with the hand holding it, she picked up a heap of sand and tried to gain her end with the augmented tool. The choice of sand was not made for lack of skill, but truly with great zeal and high hopes to proceed "as correctly as possible." When this did not succeed she grasped a long narrow stone, nudged it through the bars in an alternating pattern of precise, measured twists and impatient, careless shoves, and deposited it as far out as she could in the direction of the objective. It was quite heavy, but since it did not satisfactorily perform the function of the stick it fell short of the piece of fruit and lay just in front of it. When, immediately afterward Catalina discovered a longer splinter of reed near her and reached out with it, the stone hindered contact with the objective. Catalina immediately directed her efforts clearly and exclusively at the obstacle and shoved it carefully aside. Then she obtained the fruit.

The next goal-object was laid down still further away. Catalina reached for the stone, which still rested near her after the previous experiment, and threw it at the new goal-object. She employed the long splinter of reed at once with impatience, and when it did not go through the grating smoothly, or did not move the goal-object to her, Catalina was again on the point of biting the bad spot but now a restraint could be clearly observed, which made her pause when her teeth were already in position. Further back in the rear were plenty of sticks of sufficient length, but they remained unnoticed. When Catalina accomplished nothing with her splinter, she took the skin of the banana she had just eaten (the goal-object of the first experiment) and threw it at the new object. In the meantime, her impatience had become so great that a further failure with the splinter of reed resulted in hasty withdrawal and scattered breakage. The pieces flew out to the object, as well as a stone that Catalina had discovered behind her. Hardly anything movable was left in the immediate neighborhood. The animal whimpered softly and sadly to herself, but quickly found consolation and began to play about on the ground further back in the cage. When she came across two pieces of reed she returned with them, took them both, one above the other, in her right hand and reached out to the goal-object. After the object had been shoved sideways, the position of the animal changed accordingly. When the sticks were pushed out, they became positioned crosswise to the bars and were broken up. Now she saw an old banana skin on the ground. Catalina reached out with it in the direction of the goal-object and then threw it at the object, immediately following it with sand. Excellent sticks 15 to 20 m behind her, and quite visible, still excited no attention, even when Catalina, peevish after so many failures, turned around and stared directly at the good implements. We could now test what kind of assistance would finally lead to their being noticed and used.

The caretaker was called and approached the cage. Catalina ran toward him along the bars, almost to the extreme end, but did not notice the sticks she passed on the way. She may have expected to receive food from the caretaker and was somewhat diverted (different goal-object). The man showed her that his hands were empty and Catalina returned to the experiment. I then sent the man to the wall of the cage; at his call Catalina ran to him again along the bars, but, since the man had no food, immediately turned again to the bars in front of her goal-object, in fact in a straight path *directly over the sticks*.

The reaction was so completely zero that, a few seconds after stumbling to the grating over the superior implements, Catalina was listlessly tossing a piece of string and slivers of wood. In the course of somewhat sulky play she found a tin box about 3 m to the rear, came back and moved this too towards the goal-object. At this moment she was called by the caretaker, who meanwhile, without being noticed by her, had shoved an unusually large and thick reed through the wire mesh of the back of the cage. Catalina went to it, half carelessly picked up the reed, indifferently broke off small splinters from one end and played in this fashion for a while. Thus she now had the stick, but the goal-object was unquestionably far off and the task quite forgotten. All at once, however, she jumped up, turned around, and scampered straightway to the workplace. Nothing other than a quick solution could now be expected; but about three-quarters of the way there, Catalina's gait became halting, she sat down and at once began again to play with the stick, when suddenly a shock seemed to go through her. She jumped up again, hurried to the grating and with no trouble reached the goal-object.

Only when Catalina finally understood to some degree how to handle the stick and was, therefore, no longer absorbed merely in its manipulation, could problems be posed in which the tool was the stick, but the critical task was new. [10/1/17]

Outside in front of the bars, at a further distance was a banana to which a string was tied in an open loop running transverse to the bars, but not within reach of her arm. In the first experiment the animal reached for the banana itself and obtained it, because the distance chosen was somewhat too short. In a subsequent experiment, in which the distance from the goal-object was increased, Catalina first displayed quite diffuse behavior. She ignored the string. When she did not reach the banana, she took sand from the ground with the stick (tool accumulation) bit the end of the stick—all the more vehemently, the longer her failure continued—and finished by reducing the tool to splinters. However, after she looked about for a substitute, she fetched a new stick from the back and turned to her task again, her effort was directed from the beginning to the end of the loop. The fact that she did something different with the stick did not make plain whether she was taking into account the advantage provided by the loop. In any case, she now pulled the banana to herself with the easily reached string.

Before the next experiment the loop was laid down in symmetry with its previous position, again transverse to the bars. Catalina immediately swooped down on the string. In a later repetition the objective lay still further away, so that the loop was a full meter long. When the animal began again to fiddle with the loop, the string was accidentally caught on the stick by a fiber. The procedure changed at once; with cautious movements Catalina lifted the loop and the object up to herself.

When Catalina came to the bars, the piece of fruit was lying far off on the ground. Opposite, between the bars of the grating, was a stick that was too short. At the side, somewhat nearer to the goal-object and parallel to the front of the bars was a long stick. As soon as the animal approached the fruit, it fixed its eyes on the long stick. For a while it quietly and probingly considered the entire situation, slowly grasped the short stick, while its glance was again directed at the long one, and struggled to reach the latter with the short one. This suggested the solution, although it did not succeed in practice, since the long stick had been put down at too great a distance. The experiment was terminated.

With repetition the same thing happened: Catalina set to work again to reach the long stick using the short one, but could not succeed because the latter unfortunately always lay somewhat too far off. Since in further experiments Catalina finally displayed no kind of interest in the banana and the long stick even when she was close to reaching them, then wandered off to play, and finally went away, I undertook the same experiment only once again, two years later, in new surroundings. Three times, one after the other, there was a clear and complete solution, except that one time, when Catalina drew in the long stick with the short one, she seemed to have forgotten the banana for a moment. This was due to her concentration on the intermediate goal, and after a brief hesitation she brought the long stick to the fruit and drew it in. Not infrequently, the orang seems to "lose the thread" in the midst of its course toward a clearly targeted solution. It is as though a weaker dynamic force impels the orang as compared with the chimpanzee, so that a slight distraction or hesitation binds the animal to it as a slender rivulet loses itself in the sand.

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More than two years earlier [February and March 1917] Catalina was tested with the "detour box," which, abstractly considered, required a somewhat similar procedure. In accordance with the experience with chimpanzees, the wooden floor was removed and the edges of its three sides were placed directly on the smooth sandy soil and fastened there. As a result, a lucky accident was not as likely as before, when the stick would frequently slide off the fruit and let it bounce or slide on the smooth floor in the direction favorable to the animal.

In the *normal position* the closed transverse side faced the orang. Catalina drew the banana toward herself with the stick ( $0^\circ$ ) or diagonally ( $45^\circ$ ) toward the corner at her left; many times she shoved it  $90^\circ$  to the side. The variations from  $0^\circ$  were obviously determined by her movements, and, therefore, were always toward the left, as is natural with use of the right hand alone, as occurred before, when the fruit was to be drawn in on completely open ground. When the banana reached one of the walls Catalina attempted strenuously to lift it up. Short detours of  $90^\circ$  upward evidently posed no difficulty. When all exertion was in vain the animal became enraged, often pulled the stick back to bite its incompetent end, and finally broke it in two. Supplied with a new stick, Catalina adhered to her primitive procedure even in spite of accidental help which let the fruit bounce back half the remaining way. Neither did it help at all if I drew the correct way in the sand for her with my finger.

The experiment with the detour board is perplexing. When I resumed it after four days, Catalina busied herself in the old way for only a short time, then began to pound on the wooden walls of the cage with the stick. Then she went sideways to the rear, furiously smacking her lips, raging and snapping, and crouched down, first to fling a stone at the experimenter and then to brandish the stick at him. It did not help when I again and again replaced the banana in the middle of the open side of the detour-box. She drew it to herself only when her fury allowed her to do so.

*Cage at  $135^\circ$*  (the open box with the barrier on the diagonal to the left, as seen by the animal): Catalina held to her original course of action and pounded upon the barrier now and then when failures continued. But when the banana was accidentally pushed ahead by her stick, first to the center of the barrier area and then, once more, almost to the end of one of the side walls, she immediately changed her procedure, actually shoving the goal-object away and then drawing it the other way around past the end of the wall toward herself. It is clear that here we have the same dependence of such detour performances on the type of "detour problem," and with it on the position of the barrier, as shown by the chimpanzees in exactly the same experiments. They carried out these performances with detours clearly, even with changes of their own position.

The effect of this one experiment was enormous. After two trials Catalina began immediately to shove the banana from the starting position away from herself to the open side. Twice indeed she had the greatest difficulty because she directed the fruit too sharply to the end of the wall, and, as a result of clumsy handling of the stick, was for a time hardly able to continue. But by the third or fourth time she made a wide arc around the barrier and in a few seconds reached the goal-object, despite all her bungling.

*Return to normal position* on the following day: Again, the stick lay in plain view 8 m to the rear, but it remained outside the situation,

although Catalina looked back at it repeatedly. Very unlike the chimpanzee Sultan, Catalina at first would certainly not go in search for some minutes of a tool that was missing but that was about somewhere.

Now she took a stone and rolled it up to the barrier, as the chimpanzee would do only when completely baffled. But in the end, with a backward glance, the stick did become a tool and Catalina hurried to it. But the way was so long that she was outside the orbit of the problem; she squatted down calmly with the stick, and then, simply by playing with it, almost broke it.

Her activities were surprisingly less coherent in regard to time than were those of a chimpanzee of the same age. It can easily be recognized that in this respect she was much closer to the lower species of apes. These, by a change in their environment that may be brought about by their own actions, are easily turned away from continuing an action and turning to another that is unrelated to the first. This is remotely reminiscent of "flight of ideas." In the instance described, Catalina nevertheless checked herself; she looked first at the stick, then hastened to the bars and made strenuous efforts in vain to lift the fruit around the barrier, always operating at an angle of 0° or 20°, whichever better suited her motoric system. There were no suggestions of any aftereffect from the somewhat critical experiment of the previous day. Catalina became enraged and broke her stick. But when she received a new stick the movements with it became an incessant thrusting and shoving of the banana; at moments she seemed to become unsure and, like Nueva and Chica, fell back into the "more natural" way. In the end a distinct solution of the problem ensued. With repetitions, the primitive treatment of the problem appeared only once more.

Catalina also had her good days, and then some clear results came about. When she found no more walls to destroy, she made rapid progress gnawing through the wooden planks that supported the wire roof of her quarters. She had already worked on one so persistently that it was broken through and had to be replaced. Another was reduced to half its thickness at one point, but still held well. Since the wood was of superior quality, pecking at it had as a rule produced only small shavings and splinters. (7/21/19) A basket filled with food was set down beyond her reach, in front of the bars of her cage. Catalina gazed unhappily outside and then down at the ground around her. She did not at any time, however, pick up thin wisps of straw, which would, in fact, have been inadequate. Her glance wandered and became fixed on the well-gnawed roof beam, which was about 4 m from her. She went to a part of the bars from which the roof beam was easy to reach, clambered up and began to bite at the wood so zealously that after a time a splinter over 20 cm long came off. She climbed down to the bars with it, but was not able to reach the basket. Again she looked up at the beam, clambered up to it again and now attempted with the greatest care and caution to separate

a splinter for herself that would not break off too short. While clinging to the roof, she frequently paused in her gnawing and looked down at the critical distance. She simply let fall the shorter lengths that resulted at first in spite of all care. She descended again only when a splinter distinctly longer than the first one fell off. When this one did not suffice she became disheartened temporarily, but then clambered up once more and gnawed along the beam with tenacious industry for a long time until a slender stick of the right length actually broke loose in one piece. With this she solved the problem.

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In repeated experiments it did not become clear to me whether, if Catalina were furnished a metal wire bent double instead of a stick, she would be motivated by the extent of the critical distance to the goal-object to unbend the wire and thus lengthen it. Her behavior was too disorganized for one to be able to recognize whether she pulled the wire apart fortuitously one time, or whether it was in preparation for use as a tool. In any case, it did not happen that she intentionally and directly introduced a straightening into the arm lengthening application of the bent wire and then at once reached for the goal-object. For Catalina, inventing the double stick procedure was as unlikely as inventing gunpowder. How she *learned* this procedure will be described later in greater detail. (See p. 6, Jaeger).

Some conclusions of a general nature can be drawn from Catalina's behavior in the experiments that have been described.

1. What happens in this animal must be differentiated from what occurs in a quick witted chimpanzee in the same situation, somewhat as human beings differentiate their tactile gestalts from their clearly structured visual gestalts. When Catalina fails to see a goal-object that is not immediately attainable, it appears to emerge from a perpetual fog and to pass back into it. We often observe in the African apes clearly discernible behavior patterns that are all of a piece, carried out in a steady course and without superfluous trimmings. In this orang, such behaviors are stifled by the tendency for diffuse, muddled activity. I have no specific indication that Catalina's *perception* of the environment is more diffuse than that of the cleverer chimpanzees. Furthermore, very little in her behavior can be accounted for by a higher degree of optical "gestalt weakness" than in the African apes. However, while human beings or animals of any classification arrive at *solutions* that match the structure of appropriately directed gestalts, our observations demonstrate most amply that such adequate and high-level plans of action are not developed by Catalina in the same clear, consistent fashion as by the chimpanzee. Our previous experience with less intelligent chimpanzees make us aware that they are impelled just as much as the cleverer ones by the

emotional pressure of the situation, and produce in their outward behavior, with the greatest ingenuousness, dynamic tendencies that immediately follow from the emotional state.

Although in manifestations of this sort Catalina clearly exceeded even Rana, mere contact with the orang, and several of this animal's discerning achievements, which Rana in no way came up to, made it clear that Catalina was significantly more clever than that foolish animal. She was also more intelligent than Tschego and Tercera. The orang rarely gave an impression of foolishness in any situation, but the same stupidity always looked out vacantly from Rana's dull, flat face as an uncommonly palpable, positive feature of her expression. How is it then that the diffuse manifestations of the primarily active dynamic force were unimpeded and endowed her activity with a curiously muddled quality? This was not determined simply by a lack of intelligence, and was not directly equivalent to a reduction in the potential for intelligent behavior. In the midst of these diffuse courses of action, the same animal with a special propensity for such diffuse activity can suddenly produce accomplishments of a relatively high level. Higher degrees of insight on the one hand and stricter exclusion of *diffuse* tendencies in solving problems on the other are not necessarily linked.

2. In order to characterize an animal adequately we must have *independent* evidence concerning each aspect of behavior. With this evidence, the less intelligent animal may possibly be found in most cases, to act more diffusely. Whoever carries out intelligence tests on animals and wishes clear answers to his questions will be sadly disappointed when he observes the hasty and confusing succession of throws at the goal, most of which can be seen at once to be in vain. He will be forced involuntarily to conclude that the creature has little insight. May Buehler and Henning mark these words (both are already done with discussing experiential development): I myself was in danger at first of hastily arriving at the same misconception, and I was only set right by some of Catalina's truly high-level and distinctive achievements, which occurred now and then quite unexpectedly, as well as by a more exact comprehension of this dynamic of diffusion and the general behavior of the animal.

Unfortunately, observations of a single orang do not allow us to decide whether or not this Asian animal group as a whole and as a certain *species of animal* exhibits the highest extent of diffuse manifestations of primary forces corresponding to a particular situation, and of how far, besides, the degree of intelligent insight varies among their kind.

3. Observations of the young chimpanzee, Koko, and a comparison of Catalina's present [1919] behavior with her earlier behavior show clearly that diffuse action approaches are strongly favored in earliest childhood. Already this association with children makes it clear that the naive expression of a primitive and diffuse dynamic does not of itself provide a basis for a conclusion of inferior insight. It was assuredly a serious lack

of understanding, a dangerous assumption of times long past, that presumed simply to regard the naive child as a *human being not yet possessing all the salient characteristics of the adult*. Who can rank one above the other? Furthermore, one sees among highly qualified adults equal in intellectual achievement, on the one hand those who are steadily and consistently productive, and on the other hand, equally powerful intellects who suddenly come to rest with a complete solution only after many half chaotic (diffuse) attempts that are nevertheless always directed toward the goal.

4. Whether the phenomena just discussed can be concluded to be a question of insight or no insight depends on how one interprets the noteworthy phenomena, that is to say, to which aspect of the noteworthy phenomena one gives special weight. In the course of vain attempts to reach a goal-object, or even at the first inspection of the scene and the generation of an emotion that is in accordance with it, is it *senseless* in every respect to throw a small banana peel that is lying nearby, or even wisps of straw or a handful of sand, in the direction set by the emotion? If complete understanding of the position of a goal-object, as well as of changes in this determining factor, has been displayed, and if what occurred immediately before and after each action has been accurately assessed, a totally different interpretation is possible. *In effect*, this act is inevitably unsuccessful as far as we are concerned. But we have no right to summarily judge the determining significance of any *intention* in an action according to our own ability to carry an action through to a profitable conclusion, or to speak of senseless acts if this significance is not visibly demonstrated by an animal. We would be committing a fine philistinism! In the face of the behavior of a living creature full of temperament, observations must be presented under more headings than simple credits and debits. The behavior of animals with regard to edible fruits does not become meaningful only when the animal actually chews the fruit after plucking it. In addition, various "good mistakes" made by animals in earlier experiments show us how preposterous it is to evaluate a behavior only by its efficacy.

Serious misconceptions can indeed be found in this important area. Preyer (1882), in his book, *The Mind of the Child*, tells how he throws paper from a second-story window to his nearly two-year-old child. "He picked it up, looked at it and held it toward me with his arms outstretched, expressing his desire for me to grasp it—striking evidence of how little he recognized the distance." Rather, this is striking evidence that the adult, steered gradually in the course of life toward the goals of practicality and success as being of greatest importance, has lost touch with the multicolored profusion of naive reactions to the outside world that he still possessed as a child. I will not judge whether the two-year-old child actually recognized this sort of distance, but I dispute the right to come to a verdict of this kind. Who has not seen grown people moving

toward an incoming train with outstretched arms and showing a distinct attraction to a distant window. Since they cannot actually embrace the traveler on the train, does it follow that they underestimate the length of the platform or of their arms?

Both the child and the adult are guided naively by the forces that the situation arouses in them, and they may consider themselves to have acted as sensibly as in the most perfectly planned action. Even in northern Europe extreme cases remain of people who allow themselves to be "carried away" into actions that are clearly futile. It has been pointed out previously that the human being "understands", for example, how Sultan uses one piece of reed to direct another at a distant object and is thus able to move it slightly, in this way coming into actual contact with it. What he has done is thus in no way senseless, nor is it evidence of lack of insight. After long observation of anthropoids (since this has made me pay attention to humans as well) I consider it *entirely* inappropriate to assign an absolute and primary distinction in kind between the first emergence and establishment of strong "expressive actions" in such primitive goal-directed acts and the smooth, certainly insightful solution of suddenly posed experimental problems. Generally, only the latter has a practical effect. But the basis from which these variants of organized processes arise seems to me to be the same in all three cases: the causative situation, as a *spatial structuring of the field of perception*, which releases directed forces in a certain area as emotional objects. In objective psychology we must understand these words in a literal sense. These words then refer to conditions in the neurosomatic field. As a consequence we are forced to rethink our theoretical task.

## CHIMPANZEES ARE BETTER AT MECHANICS, BUT ORANGS EXCEL AT OPTICS!

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Koehler's description of the beleaguered female orangutan, Catalina, reveals much about the investigator and his times: A modern investigator would be unlikely, for example, to describe an individual of one species as "... without doubt 'finer,' 'more decent,' 'more reliable' ..." than individuals of another species, as Koehler does in comparing the orangutan to the chimpanzee! On the other hand, a modern investigator would be equally unlikely to give as much attention to the temperamental and emotional factors in problem solving as Koehler does, let alone to contrast species along these dimensions.

Koehler's sensitivities to temperamental and emotional factors apparently arose in part from his use of gestalt theory:

After long observation of anthropoids ... I consider it *entirely* inappropriate to assign an absolute and primary distinction in-kind between the first emergence and establishment of strong 'expressive actions' in such primitive goal-directed acts and the smooth, certainly insightful solution of suddenly posed experimental problems. Generally, only the latter have actually successful results. But the basic situation from which these variants of organized happenings arise seems to me to be the same in all three cases: the causative situation, a *spatial structuring of the field of perception*, in which an emotional component releases directed forces.

Perhaps this same perspective led Koehler to appreciate the time and repeated efforts necessary to elicit successful performances from his animals.

Modern investigators might do well to emulate not only Koehler's patience, but his interest in the interacting roles of temperament, emotion, and intelligence in primate problem solving, and their significance in generating species differences. Few would doubt that such tempera-

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mental and emotional factors as excitability, fearfulness, attachment, dependency, curiosity, and persistence influence intellectual performance both within and between species. Yet attention to such factors, when it occurs at all, tends to be anecdotal rather than systematic. This omission may be related to the tendency to allocate temperament studies in human infants to behavior genetics (Buss & Plomin, 1984) and/or to physiological studies (Kagan, Kearsley & Zelazo, 1978), that is, to dichotomize temperamental and attachment behaviors and to attribute temperament strictly to inborn tendencies and attachment strictly to learned tendencies (Stevenson-Hinde, 1991). As Stevenson-Hinde argues, this is unfortunate because a better understanding could emerge from studying the relationship between constitutional and environmental factors. Such an emerging approach may provide models for comparative studies.

Koehler's framework and persistence led him to discover that, like chimpanzees, orangutans are capable of insight, and to conclude that the primary difference between the problem solving abilities of orangutans and chimpanzees resides in temperament and motivation, the orangutan being more placid and languorous, less motivated and less persistent than chimpanzees, resulting in a muddling, diffuse style. Koehler was surprised, for example, at the time it took Catalina to comprehend the use of the stick as a tool. Koehler attributed her reluctance to use the stick as a tool in part to Catalina's morphologically determined discomfort with the stick as well as to her lack of "naive knowledge of physics" and her difficulty in making a transition from one context to another (she persisted in using the stick like a blanket, throwing it at the goal-object). Even so, he found her superior to chimpanzees at the dynamics of manipulating the stick relative to the goal-object once she had comprehended its utility. She also seemed to understand the physics of using stones as hammers without much priming. On the other hand, Koehler found that Catalina was far better than chimpanzees at clearing away obstacles, suggesting that she lacked the "optical weakness" of chimpanzees.

Koehler patiently continued his efforts to elicit tool use in the face of Catalina's persistence in such ineffective behaviors as throwing her blanket or even wisps of straw onto the recalcitrant object, rather than using a stick as a tool to retrieve it. He did not dismiss such behaviors as stupid, noting in his tantalizingly nonanthropocentric, yet Eurocentric, fashion:

Both the child and the adult are guided naively by the forces that the situation arouses in them, and they may consider themselves to have acted as sensibly as in the most perfectly planned action. Even in northern Europe extreme cases remain of people who allow themselves to be 'carried away' into actions that are futile.

He also does not, however, discuss the possible significance of these

perseverent behaviors as innate reactions which must be overcome before insightful patterns emerge as he does briefly in his original monograph.

Koehler's overall conclusion that orangutans are similar to chimpanzees in their problem solving abilities accords with recent observations which suggest that captive orangutans are more or less equivalent to chimpanzees in their intellectual and symbolic capacities (Chevalier-Skolnikoff, 1983; Mathieu & Bergeron, 1983; Russon & Galdikas, in press; Miles, 1990). Likewise, recent observations suggest that gorillas are like both chimpanzees and orangutans in these capacities (Chevalier-Skolnikoff, 1977; Redshaw, 1978; Patterson, 1980). These similarities in problem solving ability undoubtedly reflect the close phylogenetic relationship among the three species (Weiss, 1987), while differences in temperament and emotion (save a few commonalities such as love of tickling) probably reflect the influence of radically different spatial distributions and social relationships among the three species (Wrangham, 1979): chimpanzees with their alternately dispersed and concentrated foods and fission-fusion social groupings; gorillas with their concentrated foods and their stable small groups; and orangutans with their dispersed foods and almost solitary groupings (Galdikas, 1978). Once temperamental differences are systematically characterized, investigators may be able to discover social interaction patterns that shape these differences, and even to reconstruct social selection pressures that may have operated under differing conditions.

Reading this article engendered the irrational hope that hidden away somewhere is a third study by Koehler on the mentality of gorillas which would complete a trilogy on ape mentalities.

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## KOEHLER AND TOOL USE IN ORANG-UTANS

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We will comment on some specific behaviors observed by Koehler, on the basis of our studies of semi-wild orang-utans conducted in 1991 and 1992 at Sepilok/Sandakan and Semengoh/Kuching Orang-utan Rehabilitation Centers in East Malaysia. Most of our comments refer to tool use, although these may be connected with other observations.

### 1. REGURGITATING FOOD AND TOOL USE

Koehler refers to the young captive orang-utan Catalina as not being "especially clean" because she frequently regurgitates food into her hands and then licks it up again. We have observed the same regurgitation of food. In fact, it is not certain whether the food is simply masticated and spat out, or whether it is swallowed and then regurgitated. In our observations, the regurgitation was linked to tool use. After gathering a mouthful of bananas at the feeding table, the orang-utan would climb high up into the canopy, on the way gather six to twelve largish leaves (probably mango leaves) in one hand, adopt a propped position so that both hands were free, and then proceed to fashion the leaves into a fan shape, forming a "plate" of leaves. The fan is held by the fingers with the broader span facing down the arm, on which the "plate" could rest. The chewed or swallowed banana was then spat out onto the plate to be slowly re-eaten. We observed this behavior on three occasions, each time in a different animal (all females, aged 6, 9 and 15 years). All of these observations were made at Sepilok, although a keeper at Semengoh reported that he had seen the same behavior twice in a 14 year old female, indicating that this rather remarkable example of tool use is not regionally specific.

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FIGURE 1. Use of the mouth as a vessel. The lower lip is protruded so that food can be seen as it is being eaten.

It is possible that the behavior developed as a result of food provisioning at the Rehabilitation Centers: the orang-utans may take a large mouthful of food at the feeding table and then move to a more remote locality where they can feed without interruption. In fact, orang-utans are more solitarily than other primates (MacKinnon, 1971, 1974; Mitani, Grether, Rodman, & Priatna, 1991), and group feeding may not suit them. Alternatively, the behavior may aid digestive processes by increasing the exposure of the food to enzymes in the saliva. Some additional observations support the latter possibility: on several occasions very young orang-utans in the vicinity of others spat out food onto the ground and then licked it up again.

Frequently, a small piece of food was placed from the mouth onto the back of the hand, examined, and then eaten. The latter behavior is not connected to regurgitation, but regurgitation may be a further development of visual food examination. Indeed, orang-utans also visually examine food while it is being chewed by protruding the lip with a piece of food (e.g., a berry) on it so that it can be easily seen by looking downwards (Figure 1). In this case, the mouth is being used as a vessel, and we suggest that use of leaves as a plate may be an elaboration of this behavior pattern to include tool use.

As an aside, it may also be noted that Koehler regards soil eating and the smearing of soil onto the skin as an "unclean" habit. He mentions that Catalina ate soil in large quantities in the first weeks after her arrival

in Teneriffe. Soil eating is common in orang-utans living in their natural environment, and presumably it serves dietary requirements of, for example, certain minerals. We observed soil eating on several occasions at Sepilok, and Harrisson (1963) has reported that an orang-utan released into the rainforest at Bako National Park, Sarawak, went into a cave and ate soil. Three others which Harrisson (1960) observed in semi-captivity ate soil regularly from an early age, one preferring clay and the other a variety of soils. Sometimes clay is smeared over the face and arms, as Harrisson (1960) reported and we also observed, the function of this being unclear.

## 2. LIMB USE AND TOOLS

The thumb of the orang-utan is smaller than that of the chimpanzee, gorilla or human and it is placed further from the four fingers. Koehler notes that the relatively lesser opposability of the orang-utans' thumb and fingers hinders their ability to perform tasks using sticks to retrieve food. We suggest that the orang-utan thumb may have a greater degree of opposability than Koehler suggested and that it can be used in precision manipulation of at least small sticks (Figure 2), if not to apply pressure for manipulation of food dishes by sticks. Nevertheless, the position and size of the thumb may influence the positioning of the leaf-plate so that it lies along the forearm, the firm hold being provided mainly by the fingers. The leaves chosen and fashioned into a plate are strong enough to hold food when projecting out from the hand, but this holding position would require strong pressure from the thumb, whereas no thumb pressure would be needed with the position of the plate as used by the orang-utans. Furthermore, it is not impossible for orang-utans to hold leaves in a fan shape projecting out from the hand, as a human holds a fan, as they often do so to fan themselves (not using the fanning motion employed by humans but rather by making larger sweeping motions). It would therefore seem to be the extra weight of the food, together with the lack of ability to apply more thumb pressure, that determines angling of the leaf-plate along the arm.

We have observed the use of sticks to scratch the ground (Figure 2). The intense concentration of the orang-utan performing this behavior is evident from the photograph. In the context in which we observed this behavior it must only have been for self-enjoyment (play), although orang-utans also make use of twigs in a similar fashion to poke and scrape at termite and wasp nests (Harrisson, 1963). Harrisson (1963) has reported a case of an orang-utan fashioning a tool to open a wasp nest: first the orang-utan listened to the wasps inside the tree, made the hole bigger by biting, and then inserted a finger followed by a twig. The twig proved to be too large, so he bit the stick to size by taking shavings off one end, similar to Catalina's remarkable feat of fashioning a tool by



FIGURE 2. BJ using a stick to scratch the ground. Note the position of the thumb relative to the figures. Opposability is possible.

biting a piece of a beam to the length required for retrieving the food dish. He then reinserted it, holding the twig between his teeth and punching into the hole using head thrusts. Reminiscent of Koehler's suggestion, powerful use of a stick may best be achieved by use of the mouth and head, although we have observed orang-utans making powerful downward thrusts with large sticks using the grip which Koehler describes as akin to holding a dagger.

As Koehler suggests, this angle of hold might well be related to the position of the hand in gripping branches during climbing (cf. species variation amongst primates, in Bishop, 1962, 1964). The arboreal existence of orang-utans is most certainly an overall determinant of their behavioral repertoire. Catalina's exceptional accuracy in assessing the exact stick length in solving the problem which Koehler presented to her might also reflect accuracy of distance measurement and assessment necessary for survival in an arboreal environment.

Here we would like to touch on the main focus of our studies on the semi-wild orang-utans by mentioning handedness (Rogers & Kaplan, in preparation). Koehler meticulously noted that Catalina used her right hand to hold the stick which she used to pull the food dish into her cage. Interestingly, in our three observations of use of leaves as a plate the right hand was used to hold the tool (leaves). The left hand was used to arrange the leaves into the plate shape. Could this suggest a right-handed preference for holding tools? The right bias could, of course, result from chance. Many more observations are needed to determine whether there is handedness for specific functions. Chimpanzees show individual, but

not a population, bias in hand preference to hold the tool which they use for termite fishing (McCrop & Marchant, 1992).

Our large study of hand use in orang-utans, sampling more than 40 of the semi-wild individuals, has revealed a strong bias to use the left hand to touch the face (to clean the teeth or ears, for example) but no population bias for handedness in feeding. A similar left-hand preference for face touching has been reported for other primates (Dimond & Harries, 1984; Suarez & Gallup, 1986), and for a single infant orang-utan (Cunningham, Forsythe, & Ward, 1989). For feeding, some individuals show a left-hand bias and others a right-hand bias, and for yet others there is no clear bias. The handedness is much stronger when they feed in a seated or propped position compared to when they are hanging. This result is also largely supported by studies of caged orang-utans (Olson, Ellis, & Nadler, 1990), although no influence of body posture on handedness has emerged in caged orang-utans. We would stress the need to study handedness in orang-utans which have been reared in the rainforest environment with opportunity for a multitude of different hand uses in climbing, food gathering, tool use, etc. Orang-utans living thus may also show different (possibly superior) abilities in problem solving tasks, if they can be persuaded to take part in the experiments. Rarely do researchers testing problem solving abilities in primates take into account the past experience of their subjects or the contextual interactions occurring at the time of testing.

Koehler describes the lack of leaping motions in the orang-utan compared to the chimpanzee. That information is borne out by other observations of orang-utans in their natural environment. In his extensive field studies, MacKinnon saw only one example of a leaping orang-utan, and this occurred when the animal was fleeing from the researcher (MacKinnon, 1971). Unlike Koehler, instead of seeing lack of leaping as a deficiency, we interpret it as another adaptation to a highly arboreal life in a large animal. The orang-utan locomotes from tree to tree by swinging and always grasping a branch or creeper with at least one hand or foot, and usually more. Leaping is never used, although contrary to Koehler's claim, "temporary energy derived from the motion of the body-mass" is in fact used. In order to reach a distant tree, orang-utans swing back and forth on smaller saplings or branches until they gain sufficient displacement to reach their goal. In a sense, this is assisted "leaping," the only safe way for a large animal to locomote in the trees. The fact that neither the hands nor feet are designed for landing on the ground is another consequence of adaptation to arboreal life rather than being an explanation of why leaping does not occur, as Koehler claims. Thus, many of the behavior patterns of orang-utans become more explicable when they are observed in their natural environment.

The so-called destructive nature of Catalina is most likely an artefact of the caged environment, although semi-wild orang-utans are also de-

structive of plants and trees, which they break either accidentally when climbing or by design when playing, threatening (Davenport, 1967), building a nest, or when eating new shoots (Harrisson, 1960). However, given the sparse distribution of wild orang-utans (Galdikas, 1985; Mitani et al., 1991), such behavior is unlikely to be noticeably destructive to the environment. It becomes a problem behavior only in captivity or in cases of local overpopulation at the Rehabilitation Centers. In the wild, it is not dysfunctional, but functional, behavior in the sense of tool use, nest building, self-defence and feeding.

### 3. THE COGNITIVE DEVELOPMENT OF ORANG-UTANS

Exactly how "social" orang-utans are is presently a matter of debate. Their social organisation may differ in different localities (Mitani et al., 1991). Associations outside mother offspring bonding appear to occur infrequently and to be primarily for mating or as a result of aggregation at a preferred fruiting tree (Galdikas, 1985; Mitani et al., 1991). Koehler, regretting the loss of Catalina's only companion, the young male orang-utan, emphasises that it would be desirable to observe orang-utans in group interaction. Although the importance of observing group interaction cannot be denied, no matter how infrequently it may occur, the orang-utan may be less disturbed by being solitary than other primates, such as the chimpanzee. Not knowing anything of the social organisation of orang-utans, Koehler was amazed at Catalina's enjoyment of play "even by herself." In fact, the young orang-utans at Sepilok spend at least as much time playing alone as they do with each other. That is, even when plentiful opportunity for social play is available, individuals will opt for playing alone. Of course, social organisation and bonding may determine social versus individual play, and this has not yet been studied. Certain individuals do form strong bonds and so engage in mutual play, but always interspersed with pursuing their individual interests (Harrisson, 1960). The orang-utans that have been studied by Harrisson and by us are semi-wild only and relatively used to human contact. In the Rehabilitation Centers the forest is overpopulated near the provisioning site. These circumstances may lead to enhanced social play which, in the wild, might occur with much lower frequency or more sporadically.

It is commonly assumed that higher cognitive capacity in primates is linked to greater complexity in social organisation (Cheney, Seyfarth, & Smuts, 1986), but the orang-utan's problem solving ability clearly rivals that of the more "social" chimpanzee. The relatively more "solitary" orang-utan may nevertheless have complex social communication when meetings do occur (albeit less demonstrative than that of chimpanzees), and, although the individuals are more widely dispersed, complex patterns of associations between individuals may still occur over long periods of time (Mitani et al., 1991). The vocalisations (Niemitz & Kok, 1976)

and facial expressions of orang-utans seem to be extremely complex, and they have yet to be systematically studied. Alternatively, it might be argued that orang-utans had no need to develop communication skills to the same extent as group-living species, but that they instead developed their cognitive capacities for solving problems in relatively solitary existence.

Similarly, Catalina's apparent lack of goal-directed behavior, or her easy distraction from the task set by the experimenter, may be a reflection of the relative solitariness of orang-utans compared to chimpanzees. Group-living individuals must compete by focussing on a task and completing it in minimum time, whereas a solitary individual has no such group pressure for obtaining resources. Therefore, even if Catalina's behavior is characteristic of her species, it should not be interpreted as indicating a lower degree of cognitive evolution. Present-day researchers are far less inclined to draw generalisations such as these, although elements of this approach still underlie much thinking on the evolution of behavior. Even though genetic hybridisation studies indicate that orang-utans evolved before chimpanzees, the behavior of orang-utans, whatever it might be, should not necessarily be interpreted as being more primitive.

Finally, in place of a conclusion, we would like to note the sex bias in Koehler's account. Koehler attributed possible age and state-of-health differences between his two orang-utans to sex differences in behavior. Here his interpretations of sex stereotypes were clearly a product of his time and social attitudes. To our knowledge, there has been no study of male-female differences or similarities in behavior of orang-utans. Koehler's expectations and hopes that the male might do better than the female reflect his own personal views rather than scientific evidence. The Koehler article reminds us of the need to conduct such studies from a non-culture-bound perspective, if that is possible!

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Ethel Tobach, Editor

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